

DECEMBER 1976 75 CENTS

# Popular Mechanics

**OUR NEXT EARTHQUAKE:  
HOW SOON?**

**IS YOUR CB OBSOLETE?**  
Get ready for 17 new channels  
and sunspot blackout!

**THE ABCs  
OF FRONT-  
WHEEL  
DRIVE**

**New fire alarms  
that can save  
your life**

**3 MORE PLANS!**

**PM's handsome  
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**Hottest offshore racers**

**CHRISTMAS  
SPECIAL!**



**2 enchanting  
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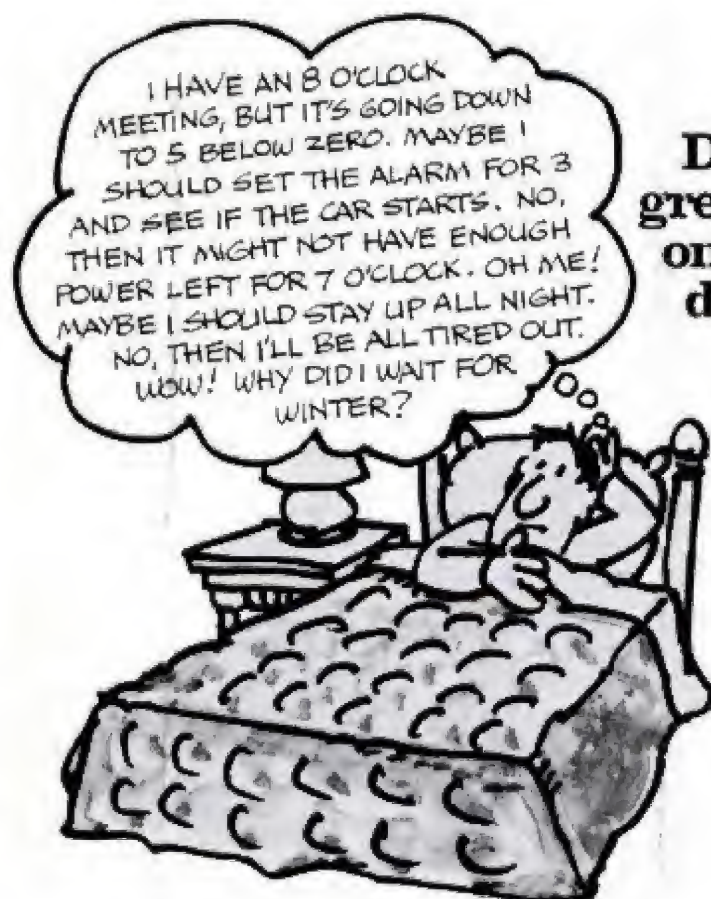
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Delco's E-5000

Delco's Freedom



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with the names  
you know.**



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# Popular Mechanics®

**On the cover**  
Pickup trucks, called the "hot rods" of the '70s, are today's new hard-muscle sports cars, including this Ford F-250 Custom Styleside model. Popular options are pushing many sales at twice the base price.  
Photo: Wallace Alfred Wyss



DECEMBER 1976

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Robert A. Georgine.

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Robert A. Georgine, President, Building and Construction Trades Department, AFL-CIO.









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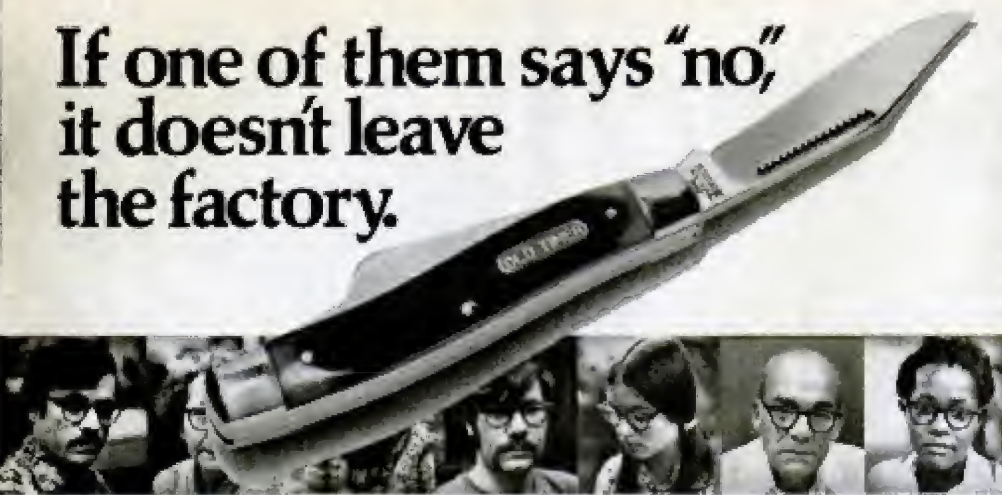


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# LETTERS

## TO THE EDITOR

### Great—but not enough

*Working Works of Art* (page 72, Oct. '76) was great—but not nearly enough. I've owned a Record Works Multiplane for years. It was given to me by my father. Also a Record breast-drill that'll do the work of a 3/8-in. electric job in half time. I don't have a Primus plane, but do have an old Elcord-Arundel that was my grandfather's. Still going strong and doing a great job.

Hand tools build pride of work. (Oh, I do have power, but only for the rough work.)

Your story should have gone on for six pages. There's magic in these tools. More in the ability to use them. Even more in the ability to understand the capability of such instruments.

ED JAMES  
NEW YORK, N.Y.

### Paper-thin bumpers?

In the interview with Art Kasper (*Chrysler Flexes Its Muscles and Works on Its Waistline*, page 94, Oct. '76) you state the bumper on the XL is .00075 inch thick instead of the usual standard bumper which is .00105 inch thick. The amount indicated is much thinner than a sheet of paper. I am curious as to what the correct thickness would be.

FOSTER W. ROSS  
MILAN, MICH.

I know they are making car parts lighter, but, damn, isn't a bumper .00075 inch thick a little extreme? Somebody goofed?

G. YANN  
COLUMBIA CITY, IND.

*The answer to both questions: Yes. The standard thickness is .105 inch; the XL is .075.*

### Open-ear driving

I believe an important point was left out of the article *Do You Have the Right CB Microphone?* (page 83, Sept. '76). While there is no question that a preamplified microphone, properly adjusted, is an asset, your photograph shows two headsets (Superex and Telex) which probably cannot be used in many areas. Most states, if not all, prohibit covering one or both ears with a headset in a moving vehicle.

As an aside, Connecticut (and probably other states) still has on its  
(Please turn to page 10)



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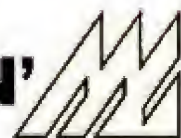
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## LETTERS (Continued from page 8)

books an antiquated law prohibiting radio transmissions from moving vehicles. The enforcement is apparently ignored; CBers and amateur radio operators are moving to have these stricken from the statutes.

THOMAS R. SUNDSTROM  
WILLINGBORO, N.J.

*We were aware of laws against driving with both ears covered; and they make sense. But laws against one-eared headsets are a new one on us. Any of our readers know of such laws in their areas?*

### Don't style usefulness out!

As a new van owner I enjoyed the October *All Outdoors* column. However, I think you are way off base in your comments on RV appearance. It is just the sort of styling that you advocate that has made today's cars so nonfunctional—so large on the outside yet so small on the inside. This we do not need in RVs. For me, the great appeal of a van is just that it is primarily a utility vehicle and as such has not suffered from the heavy hand of the stylist. I enjoy, for example, being able to get in and out without having to make like a contortionist. I hope that the burgeoning popularity of vans as personal vehicles does not encourage Detroit to allow the stylists to ruin them. CHARLES E. COHN  
CLARENDON HILLS, ILL.

### Better CB listening

Perhaps this idea will interest your readers who are into CB.

Trouble hearing CB reception with windows of your car open? If your CB rig has a remote speaker feature, try running a wire up the side molding and placing a small speaker right over your head. Remove the overhead molding and push down on the acoustical ceiling material. (In my new '76 Aspen this is a fiberboard material with holes.) The speaker will be held in place by the slight pressure of the ceiling material. PHILIP GUADAGNINOS  
ROCHESTER, N.Y.

### Best fit for a drive belt

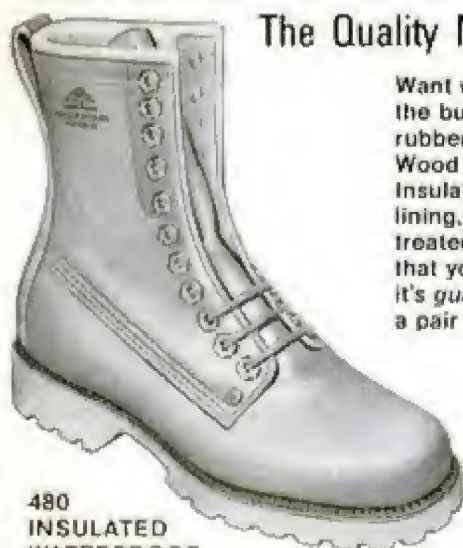
In *Change Your Drive Belts* (page 106, Oct. '76) you mention a cardinal rule for a drive belt, namely "that it fit in the pulley so that the two sides and underside are in contact for smooth power transfer."

To put it bluntly your author is wrong. To quote one source, *Machinery's Handbook*, 17th Edition, The Industrial Press, page 951: "The

(Please turn to page 14)

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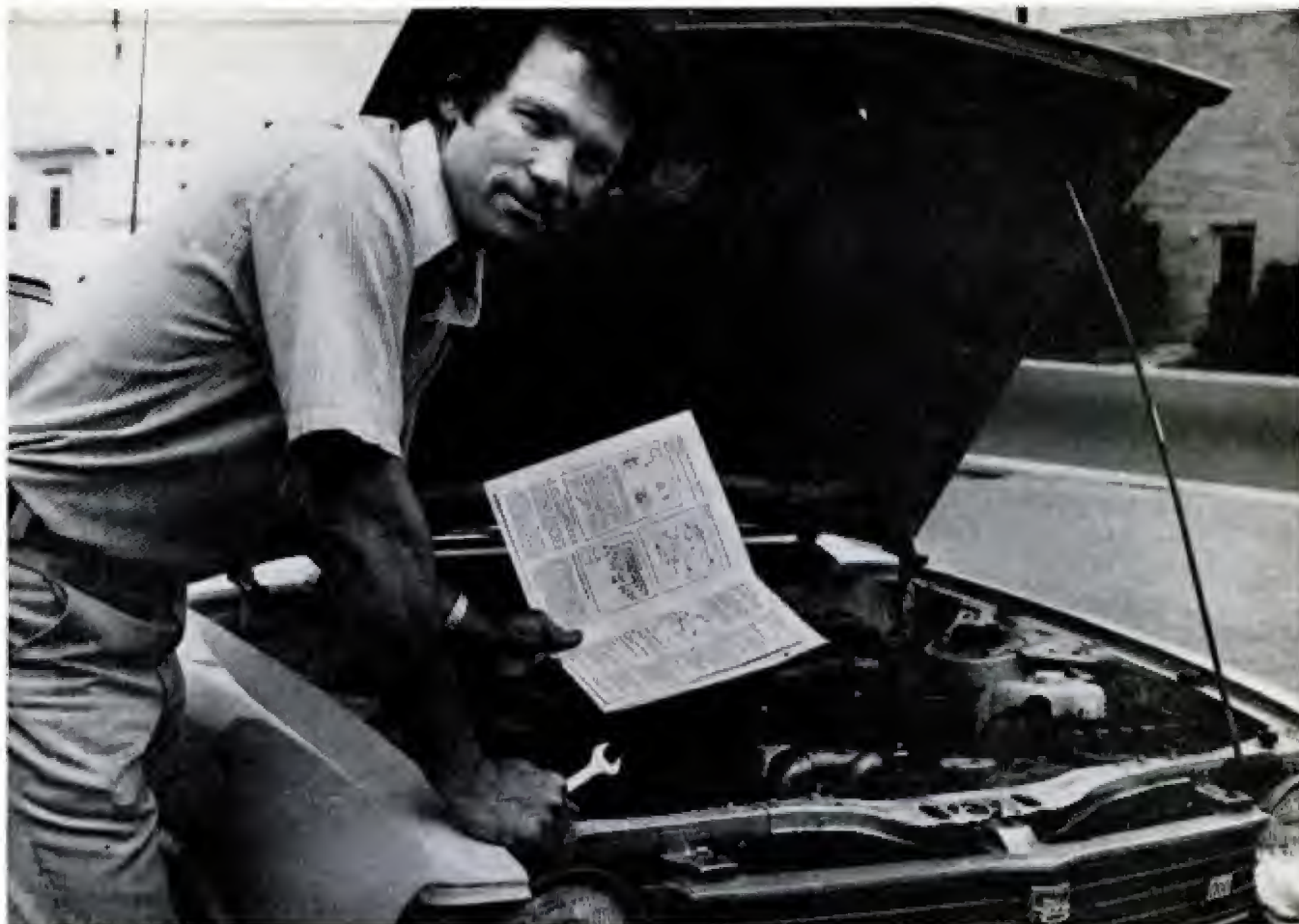
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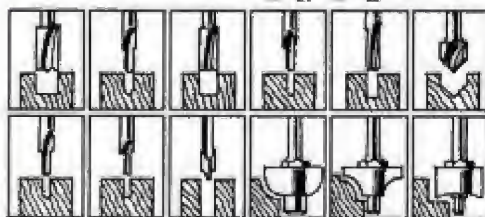
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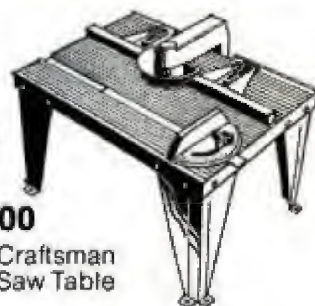
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## LETTERS (Continued from page 10)

tapered cross-sectional shape of a V-belt causes it to wedge firmly into the sheave groove during operation so that the driving action takes place through the sides of the belt rather than the bottom, which normally is not in contact with the sheave at all."

Also common sense dictates that if a belt is bottoming in the pulley it is probably not wedged tightly on its sides. Which is better—the small area of contact on the bottom or the much larger area of contact on the two wider sides? **PETER J. STAGG**  
BUTLER, N.J.

*The latter. You are correct.*

### No generation gap

Hooray for Gordon Webb and his letter to *Car Clinic* (page 60, Sept. '76). I can recall when I was 12 or 13—about Gordon's age—that my dad put a '37 Chevy on blocks on one side and supervised a change of U-joints. All my work on all cars for two or three years was closely supervised.

I'm sure you can understand the pride that any kid has when he can do his own work and be assured he is competent in that work. I worked with Dad for only five years before he died. Those were our closest times.

Please tell dads and kids: You not only can teach or learn but also come to a greater personal understanding. To hell with a big generation gap.

**HAROLD DAVIS**  
ALAMEDA, CALIF.

### Myths and delusions

I think it most inappropriate that an article such as *7 Great Quests of Man* (page 92, Sept. '76) should be published by a magazine such as yours, and, under the heading of "Science and Engineering," no less. Not only has there never been any substantial scientific evidence for the existence of these myths and delusions, but all have been thoroughly refuted many times. I am sure the technical editors and advisors of your publication can give no credence to these beliefs, and I am wondering what good purpose can be served in reinforcing the beliefs of the credulous in this respect. If people insist on reading about and believing this sort of thing, let them do so in the occult and sensational type publications. Your purpose should be to enlighten, not delude. **DON M. WILSON**  
MESQUITE, TEX.

*True, the seven quests may all be for naught. But in some cases, at least, the searches are led by reputable scientists.* ★★★



# 6 Guaranteed Products for the Active Outdoorsman

Sportsmen . . . order any item on this page with complete confidence. Every product we sell is backed by our 56-year tradition of quality, performance and an ironclad guarantee. If you're not completely satisfied, return it for a full refund.

## ALL-WEATHER GOOD SPORT

Warm at sub-zero, comfortable year 'round because the Bauer Goose Down "breathes." Fully insulated crown and turn-down storm flaps; tough nylon cotton fabric. **Sizes:** S(6½-7), M(7½-7¼), L(7¾-7½), XL(7¾-8). **Colors:** Red, Autumn Tan, Olive, Camouflage. 0138 Cap \$13.95 postpaid.

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## NON-SKID CHUKKAS

A firm footing on wet rocks, slippery decks, or anyplace that fishing, hunting or hiking takes you. The secret is the sole . . . 18 iron natural rubber with hundreds of inset grippers. Sole bonded for long life. Uppers are soft, dry-tanned Maple Cuddy leather with padded scree top. **Color:** Maple. **Sizes:** Men's C and E widths whole and ½ sizes 7-12, whole size 13. 3120 Chukkas \$19.95 postpaid.

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☐ 1462 Chamois Shirt, Neck Size \_\_\_\_\_ Color \_\_\_\_\_

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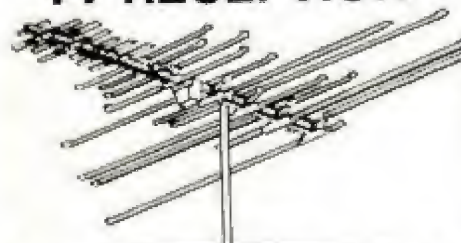
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## CHRISTMAS SPECIAL: Three-wheel pickup

This "you haul" version of the popular three-wheel kiddie car is a toy young truckers will like to find under the tree Christmas morning. The 1-in.-thick center frame consists of two pieces of  $\frac{1}{2}$ -in. plywood. Bandsaw both pieces together, then glue and clamp them face to face and sand the edges. Make the 5-in. wheels, seat, floor and front of the stake body from plywood also. Cut the rest of the parts from hardwood such as birch.

If you don't have a wood lathe, the turned tenons on the ends of the rear axle can be formed by drilling the ends for 3-in. lengths of  $\frac{1}{2}$ -in. dowel.

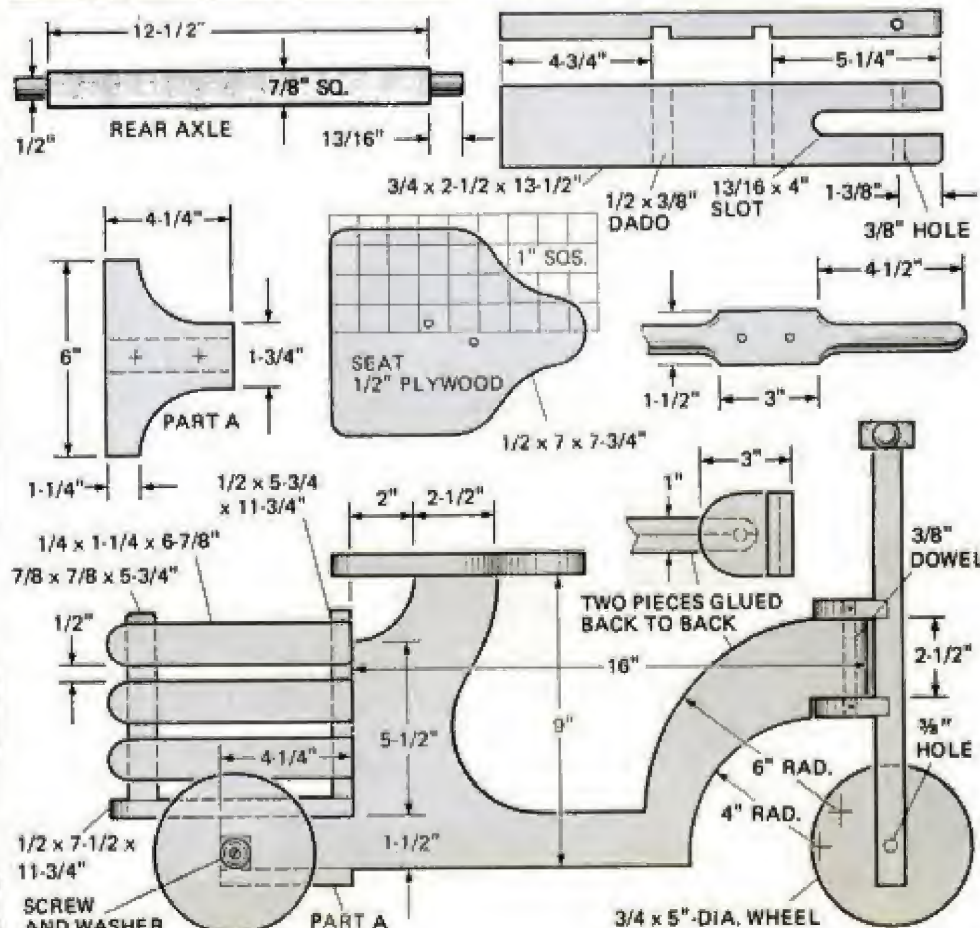
The turned steering handle can be made in a similar way. Slot the steering post for the front wheel and pivot the post to the center frame with two wood brackets and a loose-fitting dowel. Both brackets are glued and nailed in  $\frac{3}{8}$ -in.-deep dados. Part A supports the rear axle in its  $\frac{3}{8}$ -in. square notch, and a screw and washer are used to hold each wheel to the tenon. Make the holes in the wheels a bit larger than the tenons. A  $\frac{3}{4}$ -in. dowel is the front axle, glued to the post. Drill a  $\frac{1}{2}$ -in. hole in the wheel to make it turn freely and apply paste wax to tenons.

—C. L. Widdicombe



Sand all parts thoroughly, round all sharp edges. Paint with a nontoxic finish. Wheels, seat and handle can be red, the rest kept natural and given a coat of clear urethane. If you find that the seat needs extra support, a small wood bracket can be glued to each side and fastened to the seat and frame with FH wood screws.

PM art: Fred L. Wolff





In chain saws, the greater the vibration, the greater the fatigue.

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The new Super XXV CounterVibe Automatic: when you can own a saw like this, why settle for an ordinary chain saw.

## The New Poulan CounterVibe.

A Winner never stops proving it.



If it didn't absorb  
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guess who would.



Beard-Poulan Division, Emerson Electric Co., Shreveport, Louisiana. See the Yellow Pages under "Saws" for your nearest Poulan Dealer.



# DETROIT LISTENING POST



## More vans from GM, Ford

GM and Ford are considering the idea of producing "corporate" vans. Corporate means the vans would carry the name of the corporation, instead of the name of a car division, and they would be sold through all dealers handling the corporation car lines. As it is now, if you want a Ford van, you can only buy from a Ford Div. dealer. You can't buy a Mercury van. Same with GM. You have to buy from a Chevrolet dealer.

Dealers handling car lines that don't offer vans are pressing the factories to add vans to the catalog. The companies aren't eager to do this because they are trying to deproliferate, reduce the number of models and nameplates. They don't want to compound the problem by adding new types of vehicles. There's another obstacle in that the divisions without vans do not have the production capacity to make the vehicles. Solution: Bring out a van with the corporation name on it and sell it through all dealers.

## GM downsizing, second round

Next batch of GM cars to get the down-sizing treatment will be the A-body intermediates—Buick Century, Chevrolet Chevelle and Monte Carlo, Oldsmobile Cutlass and Pontiac Grand Prix and LeMans. They will be reworked for 1978. The down-sizing won't be as dramatic as the job did on its big cars this year. Where the big cars went from a wheelbase of 124-122 inches down to 116 inches, wheelbase of the A cars will be shortened by 4 inches to 112 next year.

This means the '78 mid-sizers will be about 8 to 10 inches shorter overall than the '77 cars. "It will be a more subtle change," according to a company source, "than the redesign of the big cars. If you start with a small package and make it smaller, the change isn't as evident as it is if you reduce the size of a big package. It's an optical illusion."

## Ford downsizing, first round

GM isn't the only company that knows how to build them smaller on the outside, same room inside. One

of Ford's ambitions for the new line of compacts coming in 1978 is to package the interior dimensions of an intermediate in a compact body.

## Ford accelerating diesel

Oldsmobile says its V8 diesel for a passenger car is still a year away. "Sometime during the 1978 model year," is the answer Olds gives when asked when the engine will go on sale. GM is supercautious in talking about future products, so when the company says it expects to have the diesel during the '78 model year, you can bet the job is just about locked up. Locked up enough to worry Ford, anyway. Ford has been developing a passenger-car diesel in Germany. That project is being accelerated and will likely be moved to the United States to get it moving even faster.

## Better mileage for '78 cars

Starting next year with the '78 models, cars must average a certain number of miles to the gallon. The government says so. Car manufacturers are concerned about meeting the mileage objective because they can be fined if they fall below the specified figure.

I'm taking bets most '78 cars will do better than the 18 miles to the gallon the government has decreed. This is based on two things the companies are doing right now with the '77 cars. First, they are setting up computer programs to monitor all cars on mileage. The machinery to measure miles per gallon will be tested and ready to go when the law becomes effective next year. Second, the computer programs are set higher than the government standard requires. This is to give the companies an extra edge so if there's an error, it will be on the high side.

## Original parts vs. Brand X

The auto companies make a strong pitch to get you to buy original equipment parts when you have to replace something on your car. An OE part is supposed to be superior to a Brand X part. The truth is most Brand X parts are as good as OE parts. In some instances Brand X is even better. In some cases, both

pieces come off the same dies, same machine. Only change is they are packed in different boxes, one carrying the name of the carmaker and the other under the X label.

This situation is changing and Detroit may be able to make out a stronger case for staying with OE. Parts designed by the auto companies are being made smaller and lighter along with the rest of the car. This improves mileage—not much, but every little bit helps. It will take the Brand X companies a year or two to catch up, redesign their products and scale them down. You would have to change a lot of things on a car before the weight advantage Detroit parts have over non-Detroit parts would add up to enough to make an appreciable difference in mileage. But Detroit's claim that there's a benefit in staying with OE parts is more valid than it used to be.

## This month's freebie

Shell Oil is putting out a series of car booklets you can pick up free at Shell stations. They pack a lot of good information and aren't overburdened with plugs for Shell products. There are four titles in the series so far, with more planned. If you want additional information on a particular subject, there's an address on the back cover where you can write for a personal reply.

## Ground rules on giveaways

Several companies have asked how they can get their giveaways mentioned here. Here are the rules.

The give-away has to apply to cars in general—anything that will help the average guy with his car. New cars or old and not limited to one make or a particular model. The only charge a company can make for the material is a stamped envelope. If there's a charge of more than a stamp, it's not a giveaway and doesn't qualify. Finally, if the reader has to go to a dealer or store to pick up the material, there can't be any conditions tied in with the sale of a product. If you come across a freebie you think the rest of the guys would like to know about, I'd appreciate hearing from you. ★★





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It's got to be my cigarette. Salem gives me great taste. And enough fresh menthol to keep things interesting.

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Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

19 mg. "tar", 1.3 mg. nicotine av. per cigarette, FTC Report APR, '76.



# Ford. First in vans by a comfortable margin.



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Wheels shown are optional. Check  
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## Customized for "Cruising."

Industry's first customized van. Factory built fully—  
Inside and out—a look that sets you apart in a crowd.



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Ford's out front in vans—in more ways than one. First with the van concept about 15 years ago. First in van sales now. And first with an advanced out-front design. We moved the engine forward so you have more room and downright comfort. And did a lot more. Put yourself in the leader in vans—put yourself in a Ford!



### Wild! Ford's new "Cruising" Wagon.

Part wagon, part van, all fun. Ford's restyled Pinto wagon up front, wide open van room in rear. An Industry exclusive!



### Ford Vans—fun to get into.

It's the easiest van to get in, out and move around in that Ford ever built!



93 out of 100 of all Ford Trucks registered over the last 12 years are still on the job.

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# IMPORTS AND MOTORSPORTS



## New Mercedes bends

A Mercedes-Benz station wagon is a rare bird indeed. The factory has never manufactured one for production. The few that are now in existence were done by custom coachworks—outfits such as Crayford in England, who'd knock one off for a customer who wanted one and who could afford to pay for it.

The station wagon shown above, however, was styled in Stuttgart where we spotted it in the Daimler-Benz lot. The unofficial photo shows the wagon configuration on the new W123 intermediate chassis (see report on the new intermediates in the January issue). It's likely that a 300D station wagon will be in the offing in, oh, about a year. A price around \$15,000 seems reasonable. That would one-up the Volvo 265GL—just introduced for 1977—in the luxury station wagon class.



A new coupe is also on the way and is shown here. Designated the 280CE, it replaces the 280C that's now out of production. The new coupe—powered by the same fuel-injected, six-cylinder, dohc engine that's used in the new 280E—will probably be available in North America in the fall of 1977.

Did you know this year was the 90th anniversary of the automobile?

Yep, Gottlieb Daimler's motor car took to the streets in 1886.

## 63-mpg Subaru

Don't look for this economy car at your local Subaru dealer—it's just a college prank. It was built by students at Western Washington State College. The car, powered by Subaru's 1600-cc, SEEC-T stratified-



charge engine, was hand-built by the students, who brought it in at 1200 pounds. They also used Subaru's five-speed transaxle, but installed a very high ratio fifth gear in place of the original. They got 63 mpg in tests and won the mileage, emissions and performance categories in a 10-day Sea-to-Sea Econorally from their campus to Washington, D.C.

## New racing Jaguar

The luxurious Jaguar XJ-S, which was introduced here in November,



1975 (see *Imports and Motorsports*, page 14, Nov. '75), has been set up for racing in the B Production class of the Sports Car Club of America.

The V12-powered GT won its United States racing debut at Lime Rock, Conn., with Bob Tullius of Group 44 Racing at the wheel. The XJ-S joins the Triumph TR7, Spitfire and MGs in the SCCA national competition.

## Altered Alfa



The Alfetta GT, introduced along with the sedan model last year (see page 92, Nov. '75), is exciting enough in its showroom stock form. But not content with the factory setup, Bobcor Imports has tricked it up as shown above. Not visible are many performance and handling components. Bottom line is \$11,000. Bobcor is at 500 F St. and Fifth Ave., Belmar, N.J. 07719.

## Viva Villa!



Three 250 World Championships in a row—a first in the history of motorcycle road racing—were just won by Walter Villa riding a Harley-Davidson RR-250. Adding the 1976 title to his 1974 and 1975 wins puts Villa in a class by himself. As if that weren't enough, he also took the 350 Championship this year: No one since Mike Hailwood in 1967 has pulled off such a double World Championship. ★★★





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(A TRUE STORY)

Bill De Medio of Conshohocken, Pa., has it made.

At 26, he's an electrician. The top of a trade where there aren't enough good men to go around.

But more important, Bill's his own boss and calls his own shots. "I just went into my own business. And even before the sign on my truck was dry, I got my first big job."

"The contractor for a new group of houses asked me to do the wiring. And there's bound to be more work from him and other builders."

"If it wasn't for my ICS training as an electrician, I'd still be in some dead-end job—hating what I was doing, taking orders from everyone, and never getting any thanks for it."

"As an electrician, you're the boss on the job—even when you're working for someone. You get respect, good money, and like my old man said, you don't have to take baloney from anyone."

Bill De Medio is one of our outstanding graduates. He's hard working. He's in a growing field. And he has good training.

Of course, we can't promise you'll be as successful as Bill—no school can guarantee jobs for its graduates. But ICS can give you the first-rate training you need—especially if you're interested in one of the growing careers where ICS concentrates its training.

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These degree programs are not mere stepping-stones to higher education nor are they intended for transfer toward advanced degrees. They are practical, career-oriented programs designed to help you reach your objectives without further academic training.

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At 26, Bill De Medio has more freedom, more security, and gets more respect than guys twice his age. (Photograph by Frank Cowan.)



# HOMEOWNERS' CLINIC



## Aluminum or vinyl siding?

*I'm thinking of applying either aluminum or vinyl siding to my older home. My problem is deciding, from the merits of each, which to use. The siding on my home is in good condition and the walls are insulated with batts. Can you point me in the right direction?—L. Howard, Bloomington, Ind.*

Both types of siding have points to recommend them. The colors of vinyl siding are limited, but the color goes all the way through the material; hence scratches or dents do not ordinarily show. The vinyls do tend to become brittle at very low temperatures and could shatter from a heavy impact. Vinyls are available in smooth and textured surfaces.

Aluminum siding has a longer record of use and is presently the type more commonly applied. Although it can be dented or scratched, it does have a fairly high impact resistance. Were I faced with a choice, I would choose on the basis of colors available and installation costs.

## Repair broken earthenware

*I have a five-gallon earthenware jug that should be a fairly valuable antique. But the bottom is broken. The break starts at the bottom and extends upward around the side and back to the bottom. The break is clean and I still have both of the pieces intact. Is it possible to repair the jug and if so, how and with what?—Leonard Thorson, Northfield, Minn.*

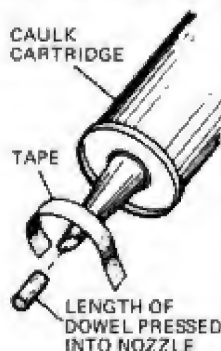
It should be possible to rejoin the parts with epoxy putty. Clean the joining edges thoroughly, then mix equal parts of the putty by kneading, or as directed on the package, and apply uniformly to both joining edges. Press tightly together and allow the putty to dry for six to 10 hours at a temperature of at least 70°F. or, better yet, 75°. Wipe away all excess putty before the material sets. When the putty is dry, smooth it flush with fine steel wool for a nearly invisible repair.

## Stopper for caulking cartridge

*How can I prevent caulking from hardening in the nozzle of my caul-*

*ing cartridge when I have a leftover amount? I've had this trouble and never have found a surefire method of preventing the waste. Do you have any suggestions?—B. Olson, Council Bluffs, Iowa*

I've had the same problem and finally hit on this method. So far it's been effective. Press a short length of dowel—sanded to the right fit if necessary—part of the way into the nozzle, allowing just a half inch or so of it to protrude. Wipe away all the caulking that may be squeezed out and then wrap the end of the nozzle with tape, winding tightly several turns to keep air from entering the cartridge.



## Suspicious window sashes

*One window in my home won't close tightly. When I push the lower sash down all the way it pulls the upper sash down an inch or so. Sashes are weatherstripped and slide easily, so I have no idea what is wrong. Do you?—Mrs. R.L. Leach, Waco, Tex.*

There is weatherstripping on the meeting rails. In older sashes it's usually held with small nails. It's most likely that one or more nails are loose, allowing the heads to protrude. These catch on the meeting rail of the lower sash and pull the upper down as you describe. You can correct this by sliding the lower sash up and the upper one down, thus exposing the weatherstrip so that the nails can be reseated. In window units of later manufacture, the weatherstrip is press-fitted into the wood of the rail of the upper sash and may become kinked or the edge turned, giving the same effect. Usually the strip can be straightened by tapping lightly with a hammer.

## Remove paint the easy way

*I have always had trouble spreading paint remover on a large surface with the widest brush. By the time I get the surface covered—not too well—part of the materials are dry and no longer effective. There must*

*be some better way. Can you help?—R.W. Stone, Grand Rapids, Mich.*

I've used a paint roller. Just pour the remover onto the surface in some quantity and roll it out. There is no problem with too heavy or too light applications here and there over the whole surface; the roller spreads the remover evenly, just as it does paint. Roll lightly with very little pressure and keep rolling slowly until the remover has done its job of raising the paint or varnish. Of course, you can never use the roller for applying paint, and you have to use a wash-off type remover. When finished just dunk the roller in water and wash it out. Do the removal job outside where there's a light breeze to carry off fumes; never work in a closed room.

## Ready or not to reroof

*I've been told that I need a reroofing job, or an "over-roof" as one bidder has called it. The roof still looks good to me. I can find no leaks by checking my attic after rainstorms. Am I getting the ripoff, or do these people see a need for a new roof? In other words, what are the signs of a roof in need?—John Smith, Columbus, Ohio*

If you're dealing with reputable contractors, you're not being ripped off, as you say, but rather they may be trying to save you from damage caused by a leaking roof later on. It's likely they see shingles slightly turned up at the edges, perhaps a shingle here and there bare of mineral coating, or that certain "faded" look of a roof about to go. These are the common signs experienced roofers look for and they are quite reliable as indicators of the need for reroofing. Runoff from the roof in heavy rains may carry loosened granules of the mineral coating into the gutters—another indicator. ★★

Do you have a home maintenance or repair problem? Send it to Homeowners Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.49 postpaid. Send orders to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.



# Smooth sailing with smooth taste.

Rough puffs never happen when KOOL is your cigarette. It's the smoothest smoke around, thanks to KOOL's taste of extra coolness. And here's an offer from KOOL for some smooth and cool sailing. The KOOL Catamaran by Hobie® a super-sleek craft for water fun. Almost 12 ft. long, it's yours at the great value of \$699 and one carton end panel from any style of KOOL. With taste and sailing this smooth, it sure is KOOL. A free copy of Hobie's warranty will be supplied upon request to P.O. Box 903, Louisville, Kentucky 40201.

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Price includes ASSEMBLED delivery at your nearest authorized Hobie dealer, or UNASSEMBLED delivery to your door anywhere in the United States. Substantial assembly required if you choose the latter option. We will contact you for delivery preference. The KOOL Catamaran by Hobie is a reassuringly stable, easy-to-sail craft with little maintenance required. Complete with a 150-lb. reinforced molded plastic hull, a 90-sq.-ft. Teltron™ sail, and natural teak rudder and centerboard.

Offer expires August 31, 1977, or when supply is exhausted. Allow up to 12-14 weeks for delivery. Void where prohibited, taxed or restricted by law. Offer limited to persons 21 years of age or older.

Please send me \_\_\_\_\_ KOOL Catamaran(s). For each one I enclose \$699 and one end panel from any KOOL carton.

Make check or money order payable to KOOL Catamaran Offer or use Master Charge or BankAmericard. Mail to P.O. Box 3000KCS, Louisville, KY 40201.

☐ Check ☐ Money Order  
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Kings, 17 mg. "tar," 1.3 mg. nicotine; Longs, 17 mg. "tar," 1.2 mg. nicotine, av. per cigarette, FTC Report Apr. '76

Name \_\_\_\_\_ Phone \_\_\_\_\_  
(I certify I am 21 years of age or older) (Required)

Address \_\_\_\_\_  
(Undeliverable to P.O. Boxes)

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
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# WINNEBAGO INTRODUCES THE GREAT

## THE SPORTSMAN'S DEN.

It's a hunting lodge that goes where the game is. A fishing camp that moves from seaside to stream to lake. This trim, 25-foot motor home handles easily at highway speeds or on back roads, lets you follow the sport and the seasons wherever you like.

### **Bring all the gear you need.**

There's a special place for everything in the Sportsman's Den. A built-in rack for fishing rods, a gun cabinet and a shell drawer that lock safely. Extra storage space up on top and below the floor line. Even a trailer hitch for towing a boat.

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The wide-open floor plan provides ample living and sleeping space for a family or four husky men. The bathroom includes separate shower stall. The dinette top reverses to become a felt-covered game table.

Sportsmen's wives especially will appreciate the full kitchen with generous counter space — as well as the smart



interior decor that features rugged corduroy upholstery, plaid carpeting and patchwork vinyl seats for driver and co-pilot.

Important "extras" like a 28,000 BTU furnace, rooftop air conditioning and 4000-watt generator, AM/FM stereo radio and tape system are all included at no extra charge. Best of all, is the Den's affordable price.

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Built on Chevrolet chassis, both the Sportsman's Den and C25CR general-purpose version are 25% longer than last year's Minnies. And cab roof cutouts add extra headroom and easier access to the driver's section on all "mini" models including





# INDOORS FOR OUTDOORSMEN.



the 23RB, 23RD and 20RG. Add in Winnebago's well-known quality construction and you'll see why we say this year's Minnie Winnies are the biggest mini-motor home values on the road.

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Now, with all new Winnebago motor homes comes an exclusive, comprehensive package of benefits that travels with you wherever you go. The Winnebago Homeowners Plan protects your investment inside and out. It locates some 300 authorized service centers all across the U.S., in Canada and Alaska. Details our customer

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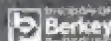
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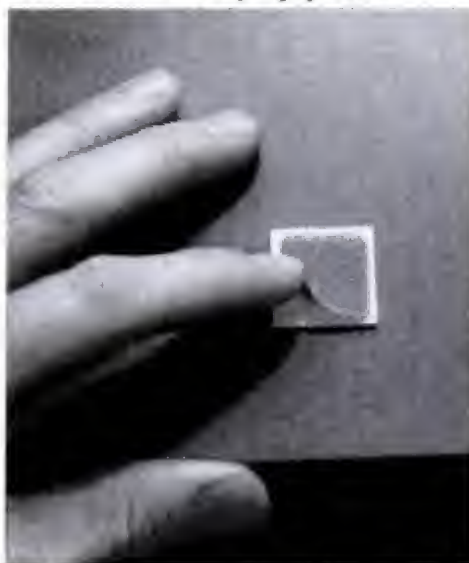


**The World's Most Experienced Automatic Cameras.**

## PHOTO HINTS

### FROM READERS

#### Velcro holds display prints



Mount your prints on the wall with Velcro hook-and-loop material, and you can change pictures easily without harming them or nailing hangers into the wall. Cut Velcro strips into small squares, and staple each one to a square of adhesive foam tape. Stick the "loop" square on the back of your mounted print, centered and near the top, and stick the "hook" square to the wall. One square per picture will be enough to support even mounted 16x20 pictures, and you can use more for larger or heavier ones.—*Bob Connors*





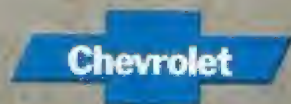
Last year  
Chevy Nova  
captured  
the Los Angeles  
Sheriff's Dept.

This  
year  
we're after  
you.



**Introducing the '77 Nova.** Last year the Los Angeles Sheriff's Department tested a specially equipped '76 Chevy Nova against five cars submitted by other car makers. They put the Nova through 24 different tests of durability and performance. When all the tests were over, the L.A.S.D. decided to order 222 Novas (the largest single order for compact police cars in U.S. history).

The same people who built these Novas for the police build three Nova models for you. And when you get right down to it, a lot of the things the police look for in a car are the same things you look for in the car you drive. This year, we'd like *you* to test a new Chevy Nova. Once you've experienced it, you'll know why Nova won its star.



You never needed Nova more.



# ALL OUTDOORS



## This year's best

Among the 10 most interesting outdoor products of 1976, you'll find some that are old and some brand-new. Our list includes updated gear we've liked and tested, plus items that have never been published before.

■ One neat general-purpose improvement is a refreeze bottle that is filled with water or beverage, prefrozen in your refrigerator, and fastened into the special compartment in the lids



Cast once with the new compact St. Croix Fishing Machine and it extends from 15 to 66 inches. Rig up from built-on "range-finder" reel and telescopic rod is ready.

of coolers and ice chests. It's made by Gott Manufacturing, Winfield, Kans. The container keeps the rest of the contents cold so ice isn't necessary, and the "coolant" can be drunk once it has thawed. It's a cool idea.

■ Telescopic fishing rods are new convenience favorites, and St. Croix Tackle in Minneapolis has come out with the "Fishing Machine," a 15-inch model that extends to 5½ feet and has a spincast reel built in. Compact enough for a backpack or most glove compartments, the chunky-looking \$25 unit proved easy enough for my young daughters to use, and has a "range-finder" in the reel so casting distances can be preset. It's handy, slick and, best of all, catches fish.

■ Safety afloat is aided by a couple more innovations from Minnesota. Stearns, in St. Cloud, makes a new



New glues of cyanoacrylate, like Willhold's E1 Flash Glue, can lock nuts, repair gear in seconds. Also note Tooth Saver line and knot cutter that mounts on reel screw.

life preserver for toddlers up to 30 pounds that can keep them heads-up if they should fall in. Called Kindergärd, the vest has a big, boxy collar that's certainly worth the funny look in return for so much safety.

■ Vexilar, in Minneapolis, best known for its advanced marine electronics products, has a jacket to bounce back radar waves. The light, handsome \$33 metalized windbreaker, named Radarjac, is said to provide a better target on radar scopes than some big standard rigging reflectors. With large commercial craft around, this jacket is an easy and attractive way to help avoid collisions.

■ Knives are now available of such quality that they can double as outdoor equipment and collectors' items. Schrade Cutlery has an American

(Please turn to page 39)

Fine new knives by Schrade Cutlery. \$20 Sharp Finger at left and \$25 Folding Hunter, are from the limited-edition Scrimshaw series with lifetime warranty. Whaling scenes are engraved on handles; sheathes are embossed leather.



65,000 more technicians needed by 1980\*

## Learn Air Conditioning, Refrigeration and Heating.

### Learn at Home With NRI's Master Course Program In Your Spare Time

Start a well-paid career in the field of air conditioning, refrigeration & heating with practical at-home training from NRI. The NRI program was developed with technical assistance from the York Division of the Borg-Warner Corporation and it uses bite-size texts, fine professional instruments and tools, and "hands-on" kits to make learning easy.

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\*U.S. Dept. of Labor Bulletin 1824





# NRI CAN TURN YOUR CB INTEREST INTO PART-TIME INCOME OR A CAREER

## Career opportunities are opening up fast for the man trained in communications.

The field of communications is bursting out all over. In Citizens Band alone, class "D" licenses grew from 1 to over 2.6 million in 1975, and the FCC projects about 15 million U.S. CB'ers by 1979. That means a lot of service and maintenance jobs . . . and NRI can train you at home to fill one of the countless career jobs available in design, installation and maintenance of communications equipment. Start training now, the NRI way, to get your all important FCC Radiotelephone License and qualify for one of these openings.

## Learn on your own 400-channel, digitally-synthesized VHF transceiver

The NRI Complete Communications Course teaches you at home to service and adjust all types of two-way radio equipment (including CB), using the one unit that is best equipped to train you for CB, Commercial and Amateur communications: a digitally-synthesized 400-channel VHF transceiver

and AC power supply. This 2-meter transceiver gives you "Power-On" training. Then we help you get your FCC Amateur License with special instructions so that you can go on the air.

## More know-how for your dollar

The complete program includes 48 lessons, 9 special reference texts, and 10 training kits. Included are: your own electronics Discovery Lab, a new Antenna Applications Lab, an Optical Transmission System, CMOS Digital Frequency Counter, and TVOM. The course covers AM and FM Transmission Systems; Radar Principles; Marine, Aircraft, and Digital Electronics; and Mobile Communications. You must earn your first class radio-telephone FCC license or you get your money back.



## CB Specialist Course also available

NRI offers a specialized course in CB Servicing. You get 37 lessons, 8 reference texts, your own CB transceiver, AC power supply and multimeter . . . for hands-on training. Also included are 14 coaching units to make it easy to get your commercial radiotelephone FCC license, enabling you to test, install and service communications equipment.

## Widest choice of courses with Quadraphonic Audio and Color TV Servicing

NRI offers five TV-Audio servicing courses as well as career courses in Digital Computer Electronics; Marine and Aircraft Electronics; Mobile Communications, and more.

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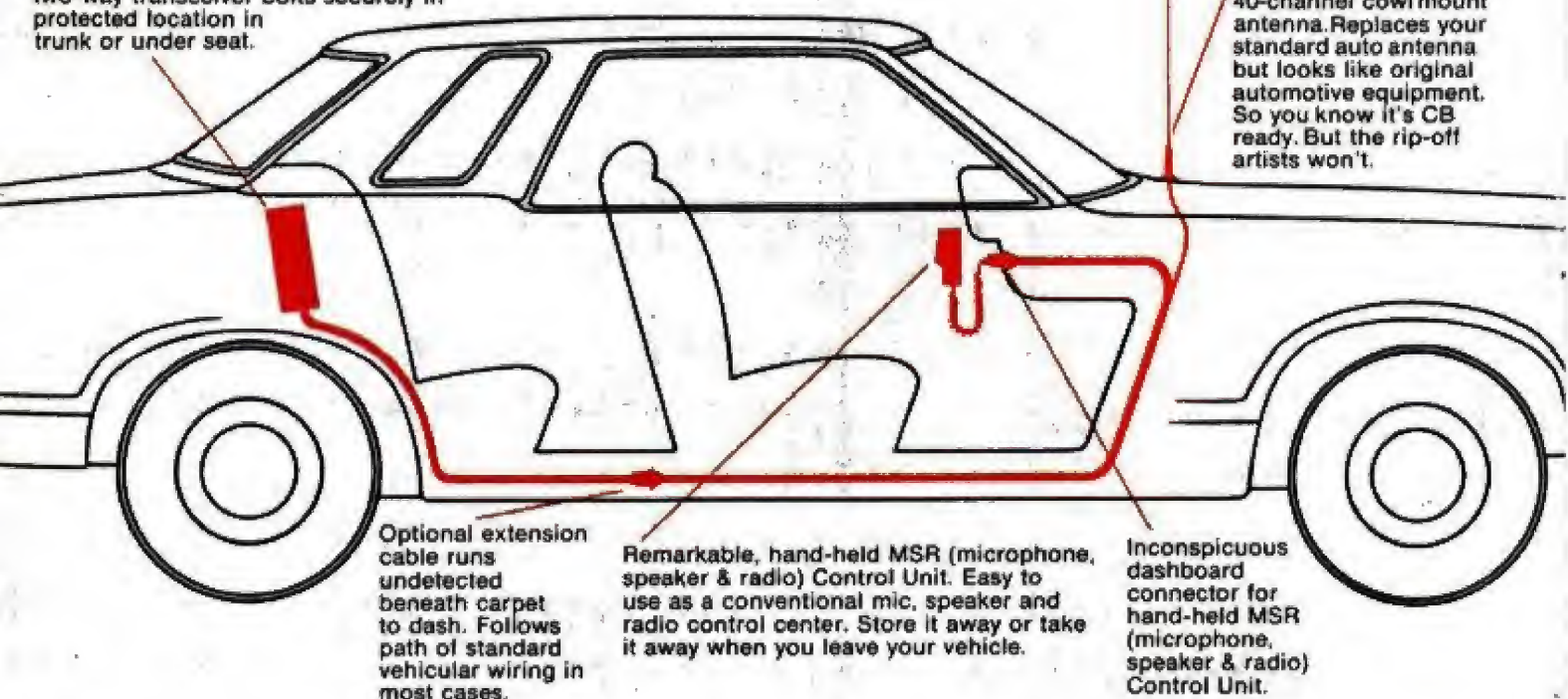
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Hy-Gain 9 (Model 2679) 23-channel citizens two-way transceiver bolts securely in protected location in trunk or under seat.

Hy-Gain AM/FM/CB 40-channel cowl mount antenna. Replaces your standard auto antenna but looks like original automotive equipment. So you know it's CB ready. But the rip-off artists won't.



Optional extension cable runs undetected beneath carpet to dash. Follows path of standard vehicular wiring in most cases.

Remarkable, hand-held MSR (microphone, speaker & radio) Control Unit. Easy to use as a conventional mic, speaker and radio control center. Store it away or take it away when you leave your vehicle.

Inconspicuous dashboard connector for hand-held MSR (microphone, speaker & radio) Control Unit.

## Now, the radio that's out of sight is ready for 40 when you are.



The Hy-Gain 9 (Model 2679) 23-channel citizens two-way mobile transceiver goes out of sight. In the trunk or under the seat. Away from temptation. And it comes with a certificate for remanufacture to FCC 40-channel specifications. It's our guarantee your new radio will be 40-channel ready.

If, after January 1 and FCC acceptance, you want all 40 channels, send us your certificate. And \$25 for remanufacturing. We'll remanufacture your radio for all 40 channels (offer expires June 30, 1977).

Our Hy-Gain AM/FM/CB cowl mount is the perfect 40-channel antenna to go with your Hy-Gain 9. It replaces your standard auto antenna. And looks just like original equipment. So you'll know you're CB ready. But the rip-off artists won't.

The only part of the Hy-Gain 9 that's around while you're around is our ingenious, hand-held MSR Control Unit for operation of microphone, speaker and radio. Take it with you or store it when you go. And all that's left is an inconspicuous connector under the dash. Everything else is out of sight.

Including performance. With the Hy-Gain 9 you get advanced noise limiting. Range boost. Automatic gain control. Mic preamp. TVI filter to help prevent TV interference. And the incredible frequency stability of Hy-Gain Phase-Lock-Loop circuitry.

See the citizens two-way system everyone's looking for at your Hy-Gain dealer. It's ready for 40 when you are. And ask about our more than 300 other fine two-way communications products. For the name of your nearest Hy-Gain dealer call 800/447-4700. In Illinois 800/322-4400.

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The following Hy-Gain 23-channel radios can be remanufactured to FCC 40-channel specifications after January 1, 1977 and FCC type acceptance.

581, 682, 2680, 2681, 2682, 2683, 2679, 3084

If you currently own one of these radios, a 40-channel certificate may be obtained from your Hy-Gain dealer.



## ALL OUTDOORS

(Continued from page 34)

classic Scrimshaw series with \$25 Folding Hunter and \$20 Sharp Finger models, each a serial-numbered, limited edition with lifetime warranty and embossed leather sheath. These blades look too fine to use, yet are too handy not to.

■ For instant repairs afield, we can recommend the amazing new cyanoacrylate glues that seem able to bond almost anything. We tested Wilhold's E1 Flash Glue with excellent results.

■ Ashore or in a stream, over socks, stocking-footed waders or just bare feet, the new \$25 Lunker fishing shoes from Royal Red Ball are designed for camping and hiking, from foam-padded collar down to cleated sole. They're worth trying to locate at sport stores.

■ CB sets are now made in a great variety of hand, mobile and base models. For sport use, we found the Beltek for motorcycles could also mount on boats, bikes, RVs and snowmobiles easily.

■ Best outdoor book of the year must be *America's Great Outdoors*, a 200-year anthology of outstanding sport stories. It's \$19.95 from OWAA Anthology, 4141 West Bradley Rd., Milwaukee, Wis. 53209, and makes a



Fishing shoe that will double for camping, hiking, wading, boating, the new Lunker from Royal Red Ball has mesh uppers that drain-dry fast, padded cuffs, cleat soles.

great year-around gift for yourself or friends.

■ And best \$10 purchase again this year is the Golden Eagle family passport to national parks. This is the annual ticket for free admission to any park, monument or seashore of the national park system.

Not everything outdoors is perfect. (We found problems when you use the KOA in-house telephone system to reserve a campsite in another time zone. And if you use motels as well as campgrounds on a trip, don't assume that your room will not be rented to someone else while you're occupying it.) But most outdoor things were fine in '76. Previews for next year look even better. ★★



# The Thoroughbreds

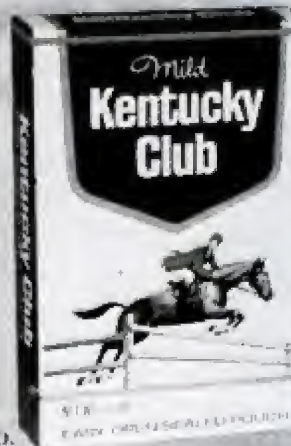
Kentucky Club and Kentucky Club Mixture. Two great American smoking blends carefully and patiently made from the choicest tobaccos.

Kentucky Club. A mild, White Burley blend that's flavor-diced for cooler smoking.

And Kentucky Club Mixture. A pleasingly aromatic blend of five choice tobaccos, slow-aged for a richly satisfying smoke.

Kentucky Club. And Kentucky Club Mixture.

The Thoroughbreds of pipe tobacco.



White Burley Blend.

Pleasingly Aromatic.

## NEW RELEASE 1976 OFFICIAL TESTING LAB RATES ALLISON #1... the BEST of ALL Ignition Systems!

★ The ALLISON "Opto" was Officially Rated #1 by a Foreign Government Testing Laboratory as the BEST "Fuel Saving" Ignition of ALL the Ignition Systems Tested, including Systems with C.D. "add-ons"!

★ Allison replaced the mechanical Breaker-Points and Condenser with a "Highly Accurate" Optical Control. A Beam of Light, passing through a specially designed "ROTOR" precisely triggers a Heavy-Duty "POWER MODULE" that BOTH "Charges and Fires" the Ignition Coil, with the "FASTEST" High Voltage RISE TIME, producing the MAXIMUM "HIGHEST ENERGY" SPARK available.

★ Since there is NO Mechanical Friction, there are NO Parts to ever WEAR or need replacing, and ONCE properly Timed, it should NEVER need any Maintenance! It never needs adjustment, it is PRE-SET to supply the OPTIMUM Performance at BOTH High and Low Speeds. The RPM Capability of the "XR-700" is Factory Tested to 15,000 RPM.

★ The "High-Energy" SPARK INTENSITY and DURATION... permits the Positive FIRING of Spark-Plugs, even under the MOST ADVERSE conditions, results in more COMPLETE COMBUSTION and Eliminates "Engine Misfire", hence fewer exhaust Emissions, IMPROVED Fuel Mileage, a HIGHER Performance Level... and helps keep Plugs FROM FOULING, which greatly extends the Spark-Plug Life!

★ Only the Highest Grade (U.S. Made) Solid-State Components are used. UNAFFECTED by Moisture or Vibration! The Allison "XR-700" was engineered to OUTLAST the LIFE OF YOUR CAR!

★ "EASY-TO-FOLLOW" INSTALLATION. (Not Necessary to Dismantle your Distributor!)

## NEW ALLISON 'OPTO XR-700'

with the Exclusive... "Built-In" SOLID-STATE VOLTAGE REGULATOR

★ The "XR-700" is a NEW, redesigned, EASIER TO INSTALL version of the Allison "Opto-Electric", with the New addition of the Voltage Regulator, making it the MOST RELIABLE and Fool-Proof Ignition System ever invented.

★ "XR-700"... Designed for those who want the BEST in Performance, Gas Mileage, Quicker Starting. Eliminate frequent Tune-Ups and Maintenance Costs.

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FREE 100% Repair or Replacement on Any Defect!

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Remember, even if you PAY Three Times as much, you cannot get a better Ignition System than the "XR-700"!

★ **SAVE! ORDER FACTORY DIRECT.**  
Send Check or M.O., Car Make, Year, No. Cyl. (4, 6, or 8-Cyl.)

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★ MC or BA Card Holders, ORDER by TOLL FREE PHONE: (800) 423-6525, Ext. 2. (When in Continental U.S.A.)

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# "A few strands of glass fiber can carry as many phone calls as this copper cable."



*Here you see laser light projected through a glass fiber, a revolutionary new way to transmit phone calls.*

Some telephone calls will soon be carried on pulses of laser light through a tiny glass fiber about the size of a human hair.

The system is called Lightwave Communications. It's being developed by our research and manufacturing people as an alternative to the copper wire used to transmit phone calls today.

It's so superior to copper that a few strands of the ultra-transparent glass can carry as many calls as a big, bulky, copper cable. That can make much more room available in already crowded underground conduits to expand service when it's needed.

Lightwave Communications may also help us bring new communications services to your home or business in the future.

And unlike copper, we'll never run out of the natural resource needed to make glass. It's called sand.

The Bell System—people using technology to improve service and keep down costs—**Keeping your phone system the best in the world.**



## Bell System



## APPLIANCE CLINIC

### Snap, crackle and pop

*Our Sears 40-gallon water heater is about three or four years old, but has started making a crackling noise that can be heard throughout the house. Do I have to prepare myself for a flooded basement?—Rod Davis, Dearborn, Mich.*

This is not the first time we've dealt with this problem, and it probably won't be the last. We keep getting an abundance of mail concerning it.

Severe buildup of rust, scale and sediment is the reason for a noisy hot water tank. Noise can occur with either gas or electrically heated units and is noticeable when someone in the house uses hot water. Water coming into the tank to replace that which is drawn off stirs up foreign material, causing popping and crackling noises.

The sediment buildup won't make your tank fail, but it does become inefficient. By removing the buildup, less fuel will be consumed to heat the water.

Remove sediment by attaching a garden hose to the drain outlet in the base of the tank and flushing out about half a tank of water. Flushing should be repeated at least once a year in order to keep the sediment and the noise at the lowest level possible.

### Toothbrush with a toothache

*I've been having my problems with cordless-model electric toothbrushes. The first one I bought was from General Electric and lasted 15 months before it stopped working. The trade-in allowance for a new one was almost nil, so I bought a new Sunbeam cordless instead. After 25 months it stopped. Sunbeam's trade-in policy is as bad as GE's.*

*I know that I can repair these units myself if only I could get them apart. I would appreciate receiving instructions.—Wilton J. Zahn, Louisville.*

So would I. Every cordless toothbrush I've ever seen has been sealed. Sealing is done to prevent moisture from getting inside the unit, which would damage parts and shorten the appliance's life span considerably. I know of no way to get inside the case

to replace a dead battery or damaged component short of slicing the case open, which would destroy the appliance anyway.

However, it just may be that the failures you're experiencing aren't inside the toothbrush holder at all, but are confined instead to the battery chargers.

To check the performance of the charger, connect a continuity tester across the prongs of the power cord and turn on the switch. Lack of continuity may point to a bad cord or switch, which you may be able to repair yourself. Also keep in mind that contacts have a way of accumulating foreign matter, preventing continuity between the battery charger and toothbrush when the toothbrush is connected to the charger. Clean the contacts by rubbing them with a pencil eraser or a piece of very fine sandpaper. This might be just the remedy your toothbrush needs.

### Water, water everywhere

*Gurgle, gurgle—help. My Speed Queen automatic clothes washer is going down for the third time. It won't shut off and water overflows. What can I do to stem the flood?—Larry Emerick, Knoxville, Tenn.*

As the machine is filling, cut off electricity. If water continues to flow, your problem is in the water inlet valve. What's happening is that foreign particles have lodged themselves in one or more bleed ports, which upsets the balance of the diaphragm. In other words, the water valve is being forced to remain open.

You can remove the valve from the machine and disassemble it for cleaning. If you don't want to do it yourself, get two prices from a serviceman: the price to clean out the valve, and the price to replace it.

If water flow shuts off when power is disrupted, check the tube to the water-level pressure switch to make sure it's not clogged with lint. Then test for a grounding problem at the inlet valve solenoid. If a grounding condition exists, the solenoid should be replaced.

Finally, if all else proves fruitless, you can pull your washing machine out of the drink by replacing the

(Please turn to page 44)

## Dremel Variable Speed Moto-Tool gives the handyman a hand.

You get fingertip speed control from 5,000 through 25,000 RPM.



A man who works with his hands works a lot better when there's a Dremel variable-speed Moto-Tool in them. Because Moto-Tool is dozens of power tools in one. It grinds, routs, deburrs, shapes, sands, carves, saws, polishes, forms, repairs, engraves and sharpens. Dial slow speeds for working on hard materials, fast speeds for working on soft materials. The Dremel Moto-Tool. There's nothing handier. See your hobby or hardware dealer. Dremel Mfg., Div. of Emerson Electric Co., Racine, Wis. 53406. Dept. T20-6L.



Constant speed Moto-Tool kits from \$29.95 to \$49.95. Variable speed Moto-Tool kits from \$54.95 to \$59.95.

**DREMEL**

Helping families to create—together.



*The Yule log burning in the Officers mess,  
Ottawa, Canada.*

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Joyfully priced.**

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You can give a more expensive Canadian, but not a smoother one.

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Yes, there's a lot of business waiting for the man who can sharpen saws, planer knives, jointer blades, wood chisels, scissors, axes and other garden, shop and home tools.

Belsaw SHARP-ALL does all these jobs quickly with precision and at a big profit for YOU. You can become Sharpening Headquarters for carpenters, builders, lumber yards, factories, home workshop hobbyists. And, you can start this Money-Making business for less than \$50.

FREE BOOK tells how to start your own sparetime business while you are still working at your regular job. People bring in their work and pay Cash—over 90¢ of every dollar you take in is cash profit.

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**\$4,000 a Year**

"Think the world of my SHARP-ALL. Am now grossing about \$4,000 a year part time, and hope to expand shortly. Now doing work for the State of New York, Carrier Corp., and General Motors."  
Lawrence Stearns  
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**Wanted to Retire**

"I had dreamed of retiring for years, but was afraid to quit my salaried job. I had never used this type of equipment, but the SHARP-ALL was real easy to learn. I sharpened 30 blades my first week — without advertising at all. Now, for the first time in my life, I can say that I am content."

Farrie Cornelius  
Wellington, Texas 79095

**\$5.36 an hour**

"On Saturdays, my big day, I take in \$45 to \$85. Other days I average less, but I figure I make between \$5 to \$6 per hour... and sometimes more. I am presently enlarging my shop, and thank BELSAW and their fine equipment for making it possible."

V. D. Miller  
Hubert, North Carolina 28589

**Had to Quit His Job**

"Bought my SHARP-ALL four years ago, and it has done everything (and more) than you said it would. I never sharpened a saw in my life, but when I had to quit my regular job, I knew I had to have something to do. Now I have more work than I am able to do — I have as many as 100 saws ahead of me at a time."

Frank Sartin  
Grandview, Washington 98920

**100% Disabled**

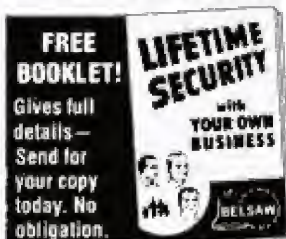
"I was disabled by an accident while employed as an iron worker. They declared me 100% disabled and said I'd never work again. I don't think I could work for anyone else but I started my sharpening business part-time and now it's turned into a full-time job with more work than I can do."

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## APPLIANCE CLINIC

(Continued from page 42)

water-level pressure switch, which you can conclude has gone bad.

## Indoor pool

*My problem is with a General Electric undercounter dishwasher. At times some of the wash water is left. At other times all the wash water remains. What's wrong?—L.J. Schnupp, Mary Esther, Fla.*

Depending upon the model, a drainage problem with a dishwasher lies in one of four places: (1) with a strainer; (2) with the drain line; (3) with the pump motor; (4) with the timer.

See if there is a strainer in the bottom of the tub. It has the job of protecting the pump by filtering out debris as the wash water passes through. The strainer may be sufficiently clogged to prevent good water discharge, so clean it very thoroughly.

Now check the drain hose for kinked areas. Straighten out the hose. If it won't stay straight, you should buy a helical spring that is somewhat larger than the hose's outer diameter. Put the spring around the hose to keep it straight. You should also test the hose for obstructions. Disconnect and blow through it to see that it's clear.

You can make a preliminary test to determine if the pump motor or the impeller (some dishwashers have two impellers) is defective. Simply advance the timer by hand to the "Drain" phase. If the motor hums, the pump should be disassembled to examine the impeller for looseness, for foreign objects that are causing it to jam and for broken vanes. In the majority of no-drain complaints, the fault is usually found to be with the impeller.

If the pump motor doesn't hum when advanced to the "Drain" phase by hand, it is probably defective and should be replaced. But this is not likely in your case since you do occasionally get partial drainage.

Neither is it likely that the timer is defective. However, if you've gotten no satisfaction to this point, check the timer visually to make sure it is advancing from the "Wash" to the "Drain" phase, and then test it with a VOM to make sure voltage is getting to the pump motor. ★★

*If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N. Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.*



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At Bell & Howell, we've been putting families like yours into the movies for nearly 70 years. And now we're doing it with the added excitement of sound.

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Because as good as you think your movies are, wait'll you hear how much better they look with sound. More real. More entertaining. And more memorable.

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While you're there, ask about the great Filmosonic rebate. If you buy—or have already bought—any Filmosonic camera, Bell & Howell will give you a \$25 rebate when you buy a Filmosonic projector.

**BHMC**

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# BELL & HOWELL





# THE PM GARAGE

## Slide-a-Wrench



For those maddeningly hard-to-get-at nuts and bolts in pinched places, here's just the tool. It's an 8-inch adjustable wrench operated by a thumb slide. Instead of twisting a knurled screw in the usual way, you just poke the wide-open jaws down on the nut, push down the slide adjustment with your thumb and you're ready to twist. Clever? You bet! And it's got an 11/16-inch box wrench at the other end.

Called Slide-a-Wrench and manufactured by Quali-Kraft in Japan, it's made of heavy forged steel and is fully guaranteed. Price is \$9.95 from tool suppliers or from America International Marketing, 1013 Park Pl., Coronado, Calif. 92118.—*M.L.*

## Lock-It tight

You can fight loose nuts with Duro's new Lock-It, the liquid lockwasher that comes in a tube. Just place one drop on the threads of any bolt or nut, and in a few minutes you've got a firm hold that won't vibrate loose.

Lock-It becomes the mechanic's friend not only for cars but for securing nuts and bolts on everything from eyeglasses to farm machinery. No amount of normal



jiggling can undo it, yet when you're ready to disassemble the part, a sharp twist with a wrench will break the bond. No harm can come to either nut or bolt and both can be reused. Lock-It is priced at \$1.98 at auto supply stores or direct from the manufacturer, Woodhill Chemical Sales Corp., 18731 Cranwood Pkwy., Cleveland, Ohio 44128.—*M.L.*

## Warn's new winches



Warn Industries recently introduced two new vehicle winches, their Models 8074 and 8274. These easy-to-install electric winches fit most U.S. and imported pickups and four-wheel drives. They mount high to counter damage from mud, snow and rocks. Installation requires no drilling and only common hand tools. Frame extensions and a custom bumper are parts of all Warn winch kits.

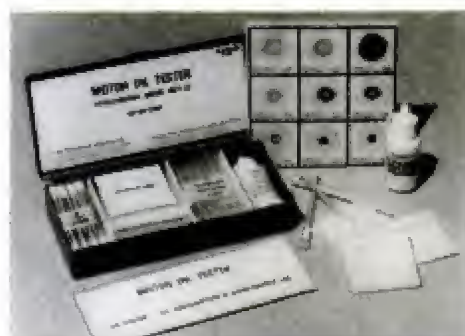
These winches run on 12 or 24-volt power, have 8000 pounds' pull, and are equipped with either roller or hawse-type fairleads. Included are a 12-foot remote-control switch and 150 feet of galvanized aircraft cable. An automatic disc brake holds the cable at any selected spot, adding to general control and safety. Accessory guards and chokers are offered.

Prices and more specific information are available from Warn Winch, Dept. PM, 19450 68th Ave. S., Kent, Wash. 98031.—*M.L.*

## Oil test kit

How do you really know when to change oil in your car? Arbitrary oil-change intervals might leave you changing oil either too soon or too late.

Now there's a test kit that deter-

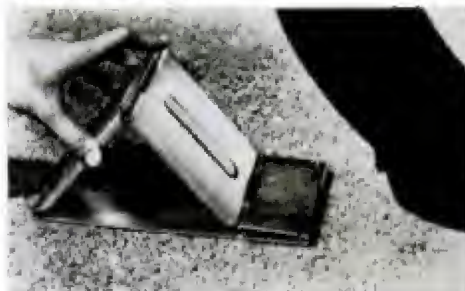


mines your oil's acidity, alkalinity, viscosity and level of contamination. The \$12.95 kit includes slides, treated swabs, reagents and everything you need to test two average cars for a year. Refills that contain four times as much material as the starter kit are available for \$19.95.

The tests themselves take only a few minutes and a few drops of oil from your engine's dipstick. You needn't be a chemist to perform the tests; instructions are simple, and results are definitive.

The Motor Oil Tester kit is available from Oil Research Associates, Box 71024, Los Angeles, Calif. 90071.—*M.L.*

## Chock a block



Where's that blankety-blank rock when you really need it? Not beside the road when you're changing a flat, that's for sure.

But Valley Tow-Rite now offers a folding metal wheel block that has rocks beat six ways to breakfast. Set up, it becomes a wedge. Folded, it's flat and compact. Use it when changing tires, unhitching trailers or launching boats. Store it under a seat, in your trunk or even in the glove box of your car.

Wheel-Block costs \$4.95, is available at most accessory stores, or you can order it from Valley Tow-Rite, 1313 South Stockton St., Lodi, Calif. 95240.—*M.L.*



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**CRANKCASE**—First time you need oil and every time you change oil, add **STP** Oil Treatment to your engine when it is running and warmed up. New and low mileage cars use one can **STP** to 4 or 5 U.S. quarts of oil (or 10% **STP** when oil capacity is below 4 or exceeds 5 quarts.) Engines with excessive wear, use **STP** up to 20% of oil capacity. **MANUAL TRANSMISSIONS, GEAR**

**BOXES AND DIFFERENTIALS**—Add 10% **STP** OR Treatment to regular lubricant.

**POWER STEERING**—Use a maximum of 10% **STP** in hydraulic fluid.

**USE LUBRICATING OIL**—Use **STP** in all lubricating oil.

**ENGINES AND MECHANICAL ASSEMBLIES**—Use **STP** in all lubricating oil.

**50% more oil**—Use **STP** in all lubricating oil.

**all petroleum products**—Use **STP** in all petroleum products.

NET  
15 FL. OZ.

# If you want to help reduce engine wear and oil consumption, follow the simple directions.

Use STP Oil Treatment at every oil change and the first time you need oil and you'll be taking a helpful step toward reducing engine wear and oil consumption in your car.

STP's effectiveness was confirmed in a series of tests conducted by Automotive Research Associates, Inc. in 27 cars driven over half a million miles. In those tests it was clearly

shown that STP Oil Treatment helps reduce engine wear, and oil consumption, too. That's because STP fortifies and toughens oil... even a premium 10W-40 to help reduce the wear rate of lubricated parts in an automobile engine.

And if you'd like to know what's in STP Oil Treatment and how it works you can read about it, plus detailed

test results, in a free booklet available from STP.® But while that takes four pages to explain, the directions are simple enough to fit on the side of the can. And if you want the security of knowing that you're helping your engine live a longer life, that's the next thing you really ought to read.

For your free booklet, write to: STP Corp., 1400 W. Commercial Blvd., Ft. Lauderdale, Fla. 33310.



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**You'll remember Raleigh. The genuine tobacco flavor. The valuable gift coupons.**

Filter Kings, 16 mg. "tar," 1.1 mg. nicotine; Longs, 17 mg. "tar," 1.2 mg. nicotine, av. per cigarette, FTC Report Apr. '76

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# CAR CLINIC

BY MORT SCHULTZ



## Slowed to a trot

*I'm heartbroken because my beautiful '75 Mustang II, which I bought used only two weeks ago, has turned out to be a nag. The car is equipped with a 302-cu.-in. engine. Around town, she performs like a thoroughbred, but on the interstate at high speed it can't take the pace and starts running hot until I rein her in. My mechanic says he's done everything imaginable to the cooling system. The cooling agent is so clear it looks pure enough to drink. What can be wrong?—Jean Ann Morrison, Canton, Ohio.*

Your Mustang may be suffering from poorly designed upper and lower radiator air deflectors. This is the only inherent condition possessed by '75 Mustang IIs that I know of which could cause the high-speed heats, but it applies only to those cars built before March 31, 1975.

The solution is simple. Remove and discard the upper radiator air deflector. Remove the lower radiator air deflector and replace it with a newly designed part available from Ford dealers as part No. D5ZZ-8349-B.

Other than this, look for a lower radiator hose collapsing under the pressure of high speed because of a weak internal spring.

## Friendly persuasion

*I've been going around and around on this with my dealer for months, and I'm almost ready to challenge him to a duel. The problem started almost immediately after I took delivery of a '75 Cadillac Coupe DeVille. The engine has been putting out a noise that sounds like a bad lifter. The dealer hasn't been able to trace the noise, but assures me it isn't a lifter. Now he wants me to believe the noise is normal, that it isn't so bad and that my ears are just too sensitive. I'm disgusted enough to believe him, and I will if you say I should.—Carl Brooks, Alexandria, Va.*

I don't want to make more bad blood between you and the dealer, Carl, but I can't buy his argument. The Caddy engine is one of the quietest, and a person having Superman-like

ears should hardly be able to hear a sound if the engine is operating normally.

I think your dealer has overlooked an advisory issued several months ago by the factory about abnormal engine noise that sounds like "a deep lifter knock or rap from the fuel pump." The advisory applied to engines in all models, except Seville.

Cadillac has traced the noise to the water-pump attaching screw in front of the fuel-pump arm, just above the water-pump locating boss. Some Cadillacs got into the field with over-length screws that were making contact with the fuel-pump arm during downstrokes.

This can be verified by backing the screw out a fraction of an inch and letting the engine run. If the noise stops, you have found the culprit.

To get rid of a noise caused by a long screw, place a .060-inch-thick washer under the screw and torque to 70 inch-pounds.

If the noise is not being caused by the screw, your dealer should do something that should have been done months ago—call for help. Tell him to contact the factory regional office and get a representative out to listen to the engine.

## Mouthwash

*Why do some 1975 and 1976 automobiles give off an odor resembling rotten eggs while most don't? There's this one guy on the block with a 1975*

*Pontiac Grand LeMans that is stinking up the neighborhood.—J. A. Anderson, Hollywood, Fla.*

The rotten egg odor is hydrogen sulfide, and it is characteristic of cars equipped with catalytic converters running with an improperly adjusted fuel mixture. Don't be shy. Tell your neighbor his car has a case of bad breath, but that it can easily be corrected by having a simple carburetor adjustment made.

## Morse code, Colt-style

*My 1973 Dodge Colt is sending me signals, and I don't like what I'm seeing. The oil-pressure light has started flickering on and off. Yet the engine performs beautifully, without any noise, has only 18,000 miles on the odometer, and uses no oil to speak of. Before I take the car to a mechanic, which is going to cost me money, I'd like to know if there is something easy I can do.—William Costello, Des Moines, Iowa*


I really doubt that your Colt is warning you of a major illness. Even if the oil-pressure warning light stayed on all the time, there should be other symptoms if there is a let-down in pressure.

Oil-pressure lights in these cars flicker or stay on when air gets trapped in the oil-pressure sending unit. This is easy to cure. Start the engine and remove the wire from the sending unit, which is on the right

(Please turn to page 50)

PM CAR CARE

**TIP**



**Stop, read and heed**

Stop before using a fuel additive or carburetor cleaner if you own a 1975 or later model car which is equipped with a catalytic converter.

Read the instructions on the can very carefully to make sure the product can be used in cars with a catalytic converter and to verify the way that the product should be used. If the instructions don't specifically state that the product is safe to use with catalytic converters, don't use it.

Heed what you read, because failure to do so could result in severe overheating of the catalytic converter, which may be damaged so badly that replacement of the costly unit will be the only solution.



side of the engine block. Loosen the screw in the center of the sending unit with a Phillips-head screwdriver to bleed air. After a moment, retighten the screw and reattach the wire.

If the light still acts up, have oil pressure checked with a master gauge. If the gauge shows pressure up to spec, the oil-pressure switch is probably bad and should be replaced. The switch is attached to the oil-sending unit: the prong-type thing that's being held by the bleed screw.

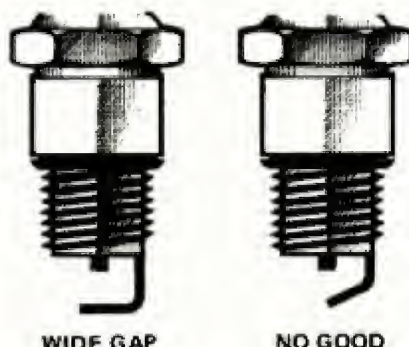
### Arm trouble

*What causes idler arms to go bad? I've had to have three replaced in my 1974 Chevrolet. My mechanic says that all showed too much motion when he shook them, but he finds nothing wrong with steering or suspension which would accelerate wear. Is he getting badly manufactured parts?—P. L. Farley, Birmingham, Ala.*

I doubt if any of the idler arms he's replaced were bad. Chevrolet equips its vehicles with three different designs. Two of them are for

### Sparkplug no no

The carmakers who have specified wide-gap sparkplugs since 1974 bring to mind the foolishness being engaged in by some owners. Stuck with a stock of "regular" plugs when they bought their new cars, some have tried to make them "wide" by bending ground electrodes to the new specs. You can't convert a plug having a gap of .030 in. into a plug having a gap of .080 in. The result will be a misfire. Drawings below show the difference between a truly wide-gap sparkplug and an imposter. The plug that's bent wide to replace a wide-gap type has its ground electrode set at an angle. And that's a no no.



passenger cars; the third is used in trucks. One of those used on passenger cars and the one on trucks display noticeable movement, even when brand new. This means that a mechanic not familiar with Chevy idler arms can be fooled.

One of the arms used in passenger cars has a tapered seat and employs a spring-and-ball assembly that maintains pressure against the seat. This is the arm that has lash, which is acceptable. The other idler arm used in Chevy cars is threaded and should display no movement when new. The idler arm in trucks has a rubber bushing that holds the arm aligned with the stud end.

Okay—no matter which idler arm your car has, the test is the same. The car is raised so front wheels rotate freely and steering linkage is free to turn. Wheels should be aimed straight ahead. Place a push-pull spring scale as near as you can to the relay rod end of the idler arm and exert a pulling force of 25 pounds up and then down against the arm. Notice how far the tip of the arm moves. In fact, have someone measure movement with a scale as you apply pressure.

For any one of the three types of

(Please turn to page 52)

# BIG DEAL ON A LITTLE STIHL.

## HERE'S THE DEAL.

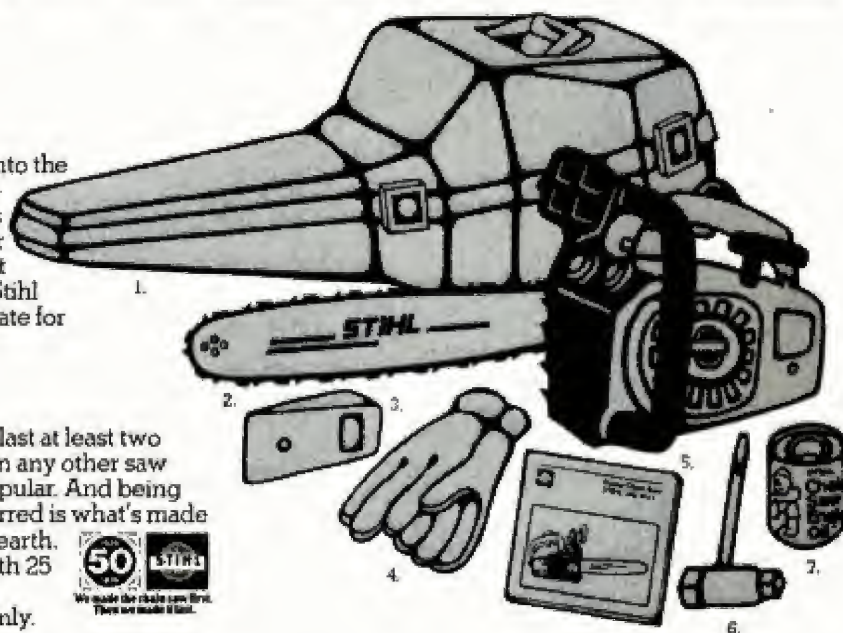
This Christmas we'd like to put a little Stihl into the hands of everyone. And to do it, your Christmas-spirited Stihl dealer will give you 25 dollars worth of the free extras shown below just for buying our tough, little 015L Chain Saw. But hurry. We can't keep this big deal on a little Stihl going long. And at 25 dollars a crack, we'd hate for you to lose out simply because we sold out.

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Our lightweight 015L has been designed to last at least two times longer, start easier and run quieter than any other saw like it. That's what makes all Stihl saws so popular. And being popular is being preferred. And being preferred is what's made Stihl the largest chain saw manufacturer on earth.

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1. Custom designed carrying case.

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8. Attractive gift box (not shown).

\*Standard equipment with all Stihl saws.



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**Talk to Cobra.** And you know you're punching through. One glance at the

29's over-sized illuminated meter tells you just how much power you're punching out and pulling in. For voice modulation the DynaMike delivers at 100%. Same way with power: The 29 transmits at maximum power levels.

**Sooner or later you'll get a Cobra.** And you'll get engineering and craftsmanship second to none. Performance that will make your first CB seem obsolete. Reliability and durability that have set standards for the industry. Above all, you'll get power. The power to punch through loud and clear like nothing else. Because when it comes to CB radio, nothing punches through loud and clear like a Cobra.

  
**Cobra**

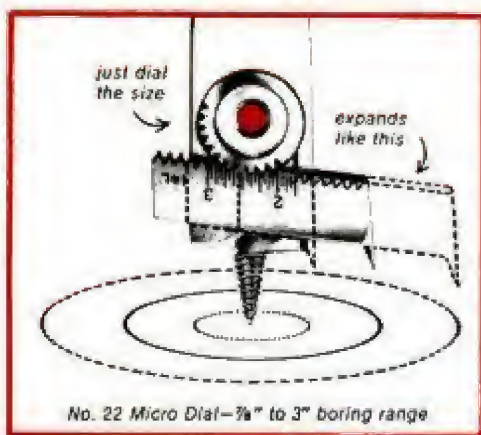
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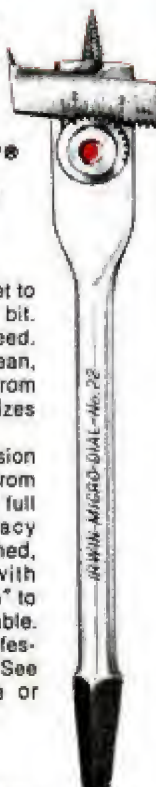


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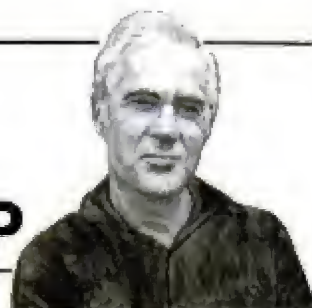
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BY EUGENE A. SLOANE

# THE BICYCLE SHOP



## Noggin protection

Is there a good bicycle helmet? I have seen cyclists wearing leather-coated foam "monkey hats," hockey and kayak racing helmets.—Tom Angelos, Rutland, Vt.

Every bicycle rider should wear head protection, in my opinion. I have totaled three bicycles in the past 10 years; two were high-speed collisions with cars (they were parked) and one involved getting the front wheel caught in a bridge joint on the Hood Canal bridge north of Seattle. All were my own fault, and any one of them could have involved a fatal head injury. I was lucky, but now the statistics are against me and I wear a crash helmet every time I get on the bike.

The "monkey hat" you mention is psychological protection only. Hockey and football helmets are cumbersome, unwieldy and hot. Kayak helmets cover the ears and create annoying wind noise. There are three helmets designed specifically for bi-

cyclists. I have rated these models in the accompanying charts found at the bottom of the page.

The MSR offers a bit more protection than the Bell, but it's hotter, has poorer ventilation. The Skid-Lid is coolest, at 10 ounces is almost half as heavy as the other two and is most comfortable to wear all day, but offers by far the least protection. The Bell, made by the people who make the best motorcycle helmets, is the best compromise. None is exactly perfect. All the helmets have their good and bad points.

The photos show outer and inner sides of the three helmets, left to right: MSR, Bell, Skid-Lid. Note air scoops on the Bell, comfortable nylon strap suspension inside the MSR, pie-plate design of Skid-Lid. Sources: your bike shop or MSR, Inc., 96th St. at Eighth Ave. S., Seattle, Wash. 98108; Bell Helmets, Inc., 2850 East 29th St., Long Beach, Calif. 90806; Skid-Lid, Box 243, La Jolla, Calif. 92038. ★★★



## RATINGS FOR 3 BICYCLE HELMETS

(Based on one-to-three scale—one is best)

	MSR	Bell	Skid-Lid
Overall protection	1	2	3
Ventilation	3	2	1
Retention	1	2	3
Weight	2	2	1
Cost	1	3	2
Comfort	3	2	1
Appearance	3	2	1
Overall quality	1	2	2
Visibility of wearer	1	2	3

## COMPARATIVE SPECIFICATIONS FOR THREE BICYCLE HELMETS

	MSR	Bell	Skid-Lid
Impact std. passed	Z-89	ANSI-Z90 (deceleration time, modified test)	NA
Shell	PVC*	Polycarbonate**	Polycarbonate**
Internal clearance	5/8 in.	1/2 in.	7/16 in.
Suspension system	Double nylon webbing. X-cross sewed to wire-form loops riveted to outer shell, plus 1/2-in. Styrofoam ring around inside brim of shell.	3/4-in. Styrofoam over entire inner surface of shell.	7/16-in. foam rubber over interior of shell.
Ventilation	Eight 5/8-in. holes; four in front, four in rear.	13 air scoops around and on top of helmet.	Four triangular openings, 2 1/2 x 2 1/2 x 3 1/2 in.
Weight	19 oz.	19 oz.	10 oz. less accessories 12 oz. with accessories
Cost	\$22.50	\$32.50	\$27.50 less accessories \$33.50 with accessories
Accessories	None	None	Visor, rear-view mirror

\*360,000 p.s.i. flexural modulus.

\*\*340,000 p.s.i. flexural modulus.

NA: not available



**Experience is the best teacher.** You might settle for any CB first time around. Understandably. A lot of people think they're all pretty much alike. But you'll soon discover that, like everything else, there are exceptions.

**Ask the pros.** America's long distance truckers. These guys talk CB day in and day out. And they demand the best. That's why truckers refer to the Cobra 29 as "The Diesel Mobile."

**Listen to Cobra.** You'll hear a big difference. Because the Cobra 29 gives you features which assure crystal clear reception. Like switchable noise limiting and blanking, to cut out practically all pulse and ignition interference. Add squelch control and RF gain and you've got exceptional—adjustable—receiver clarity. Even in the heaviest CB traffic. You also get Delta Tuning which makes up for the other guy, because even off-frequency transmitters are pulled in. Perfectly.

**Talk to Cobra.** And you know you're punching through. One glance at the

29's over-sized illuminated meter tells you just how much power you're punching out and pulling in. For voice modulation the DynaMike delivers at 100%. Same way with power: The 29 transmits at maximum power levels.

**Sooner or later you'll get a Cobra.** And you'll get engineering and craftsmanship second to none. Performance that will make your first CB seem obsolete. Reliability and durability that have set standards for the industry. Above all, you'll get power. The power to punch through loud and clear like nothing else. Because when it comes to CB radio, nothing punches through loud and clear like a Cobra.



**Punches through loud and clear.**

Cobra Communications Products  
**DYNASCAN CORPORATION**  
6460 W. Cortland St., Chicago, Illinois 60635

# IF YOUR FIRST CB ISN'T A COBRA YOUR SECOND ONE WILL BE.





## CAR CLINIC

(Continued from page 50)

idlers, if movement is more than  $\frac{1}{8}$  inch, then the idler arm should be replaced.

Application of the exact amount of pressure is the only exact way of testing Chevy idler arms. Pulling and pushing on the part by hand is not accurate.

### Furious choking

*Can you tell me why my 1975 Plymouth Fury with 318-cu.-in. engine and automatic transmission is so hard to restart for a few hours after I drive it a short distance? The trouble happens only in chilly weather. After much coaxing and hassle the engine finally does start, but as if angry at being disturbed it belches black smoke from the exhaust.*—Ken Turner, Lancaster, Pa.

You apparently haven't heard that a new two-stage choke switch has been issued by Chrysler to relieve this over-rich fuel condition brought about by the choke plate staying closed too long during colder weather. The new choke switch (part No. 3755750), which your dealer should put on for you free-of-charge, allows quicker choke plate response. Get it.

### Lowering his cholesterol

*One time it starts—another time there's no response at all. I'm speaking of my '75 Thunderbird. As luck would have it, whenever I take the car to my dealer to show him, the engine responds instantaneously and I'm left with egg on my face. Can you offer some advice?*—Howard Sobol, San Francisco, Calif.

Sure can, Howard. Failure of the T-Bird to start on occasion (and also the Lincoln and Mark IV) can usually be traced to a loose ground wire connection at the starter relay. You will find three connections on the relay. The ground wire is the one not next to one of the others. It's off by itself, but no matter. Tighten up on the attaching nuts. The book calls for torque of 18 to 30 inch-pounds. If you are doing it yourself and don't have a torque wrench, make 'em snug.

## SERVICE TIPS

■ An advisory from Chevrolet warns that some owners are inverting the air cleaner lids in their cars, believing that engine performance and gas mileage will be improved. Instead, they are finding it leads to loss of power, poor cold-weather performance, excessive noise and altered

emissions levels. Take it from Chevy and me: It won't work.

■ The battery support trays in some Chrysler-built Aspens and Volares have developed minor cracking along welds and around drain holes. The company suggests that if yours falls into this category you take the car to the dealer and have repairs made according to service bulletin 23-31-76. The shop will weld and refinish all cracked areas and add a new support strut.

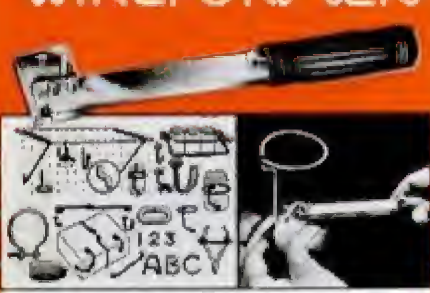
■ If the vinyl roof on your Ford-built car has faded or discolored, because you failed to clean it at regular intervals and you now regret your neglect, take heart. In many cases, the luster of the roof can be restored by cleaning it with a multipurpose cleaner Ford and Mercury dealers sell under part No. B8A-19523-A. If the cleaner fails to do the trick, a dealer can restore the roof to like-new condition by using a vinyl repair system Ford has issued. Instructions to your dealer are contained in service bulletin 112, article 1485. Neglect costs money. This job isn't a freebee. ★★★

### GOT A PROBLEM WITH YOUR CAR?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

New Tool Works Wonders With Wire!

## WIREFORMER



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WIREFORMER is a simple, precision made, vise-held tool of innumerable uses. Make your own peg board hooks, clamps, handles, braces, brackets, etc.—any shape you want. Forms an eye of 3-16" inside diameter (just right for any nail, screw, or bolt up to that size). Even uses coat hanger wire. No pliers needed. WIREFORMER works with the pressure of one finger. Straightens wire if you make a mistake. Cuts wire where you want it. Forms any angle, arc or circle. Bends right and left. Tool is case hardened, plated with plastic handle. Fits in pocket. Complete instructions, illustrated brochure showing many things to make.

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3. Offer begins 11/15/76 and expires midnight 12/31/76. All envelopes must be postmarked before then.

E-T will mail your rebate check. Allow 4 to 6 weeks. Offer void where prohibited or otherwise restricted. Limit one coupon per family. E-T reserves the right to verify dealer purchases and invoices of sufficient stock within past 90 days to cover rebates. Any violation constitutes fraud.



# SCIENCE WORLDWIDE

## New portrait of big comet

The five-picture composite of Comet West (below) was made from photos taken recently at the Joint Observatory of Cometary Research in New Mexico. From extensive observations of the comet, scientists have produced the first detailed ultraviolet spectra of a comet, enabling them to identify chemical components as well as internal processes. A major component identified for the first time is carbon monoxide. Comet West measures some 50 million miles from its head to the end of its gaseous tail.

The Joint Observatory was established by the New Mexico Institute of Mining and Technology, Socorro, N.M., and Goddard Space Flight Center, Greenbelt, Md.



## A tasty way to convert whey

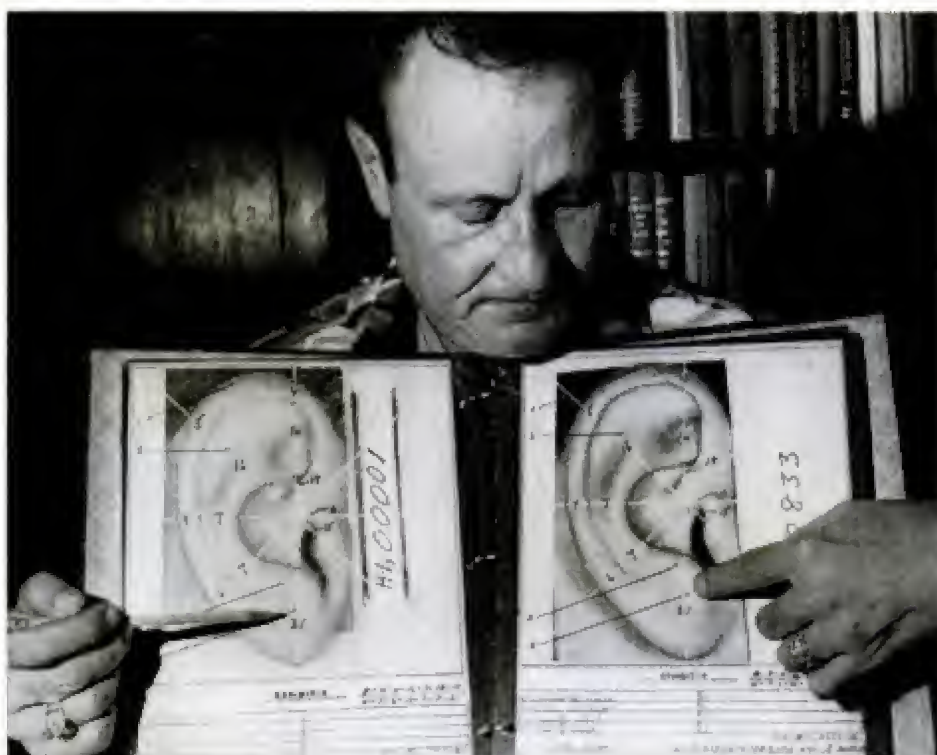
Cheesemakers have a problem: For every pound of cheese produced, there are about 10 pounds of whey, the part of the milk that's essentially water. Though the whey can be made into protein concentrates, this takes a lot of energy. Simply disposing of the whey creates a pollution problem.

Now scientists at Oregon State University have come up with a tasty alternative. They add yeast cultures to the whey, causing the milky fluid to ferment. The result: a wine that experienced tasters compare favorably with apple wine and even Pinot Chardonnay.

No energy is required and all the whey is utilized. The researchers say the method can be used by small cheese plants because no elaborate or expensive equipment is needed.

## But will crooks don earmuffs?

No two human ears—even your own—are exactly alike. That's the contention of Alfred V. Iannarelli,



who has photographed and classified more than 35,000 pairs of ears since 1949. A staff member of the University of California at Hayward, he has discovered key identification points on the external ear (as he indicates in photo) that do not change throughout one's life.

"Earology," as the system is called, was developed to supplement identification by fingerprints. Mr. Iannarelli says he has used his system to identify individuals for the FBI and CIA.

## New crystal grown in lab

A new crystalline substance—not found in nature and never before produced in the laboratory—has been synthesized by scientists at Bell Laboratories, Murray Hill, N.J. In their announcement, the researchers said the achievement pointed to tailor-making materials with specific electronic, optical and mechanical properties.

Called a monolayer crystal, the new material was assembled by adding atomic layers of arsenic, aluminum and gallium to a base of gallium arsenide, a semiconductor. The sequence was repeated hundreds of times to produce a crystal resembling a thin, highly polished mirror. The material has the same average composition as crystals used in fabricating light-emitting diodes (LEDs).

## Blood color triggers monitor

An oximeter normally is used in intensive care units to monitor patients after surgery. Now scientists at the School of Aerospace Medicine, Brooks Air Force Base, Tex., are using the device as a safeguard for volunteers subjected to high G forces on the human centrifuge or abnormal thermal stresses in environmental chambers.

The oximeter is placed on the subject's ear. It consists of a light source on one side of the ear lobe and a photosensitive receiver on the other. As the amount of oxygen saturation in the blood decreases, the color of the blood changes, with different wave-lengths corresponding to different degrees of oxygen content. When the saturation level goes below safe minimums, an alarm is triggered in a monitoring station. Future applications may include inflight monitoring of pilots making sustained high-G maneuvers. ★★★



BY  
JOHN F.  
PEARSON



# 6 good reasons (and 1 super reason) why your new microwave oven should be a Kenmore.

**1** Special temperature-sensor shuts the oven off when the meat's just right. Insert it in the food like a meat thermometer. It's completely automatic. When the roast is good and juicy, this Kenmore Microwave Oven shuts itself off—automatically.

**2** Range of settings—from simmer to top speed. Casseroles and stews that need slower cooking get it. This oven also has a special setting for sautéing. A roast setting. A defrost setting. And, of course, "high" for top microwave speed—like hamburgers in 4½ minutes.

**3** Easy-to-read digital timer—important, because many microwave recipes must be timed *within 5 seconds*. With this Kenmore, that's no problem. Just set the dial. It couldn't be easier to read.

**4** At last! A microwave big enough for big roasts. As long as your meat doesn't exceed 7¼ inches in height or 16 inches in depth—it will fit in. That much meat can feed as many as 10 people.

**5** This Kenmore comes with free cookbook: 197 pages long with more than 425 recipes—and it's lavishly illustrated in full color.

**6** Easy to clean because the interior is finished in acrylic. Just wipe this Kenmore clean with a damp cloth. Spills can't "bake" on.

**7** The Super Reason: Kenmore offers you Sears service. Just call the Sears store nearest you. The Sears service representative will be there *fast*—and you can be sure he'll show up. Don't forget Sears dependability and quality. And ask about our convenient credit plans, too. The Kenmore Microwave Oven—only at Sears, Roebuck and Co.



The six good reasons apply to Model No. 99871. Also available through the catalog.



Friday, Nov. 26, ABC-TV, Sears presents  
★ An All-Star Salute to John Wayne ★

## Kenmore. Solid as Sears





1943



1948



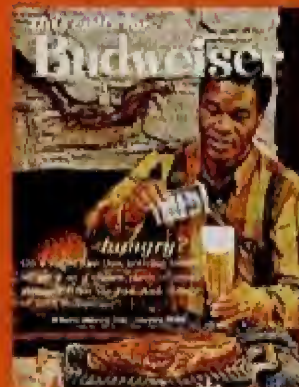
1948



1958



1958



1962



1963



1967



1972



1973







1906



1933



1933



1933



1946



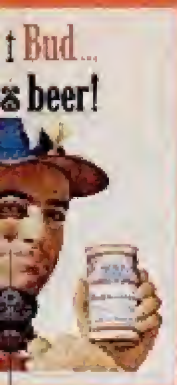
1946



1951



1953



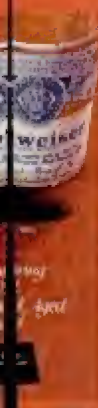
1964



1965



1965



1974



1975



1975



1976



# OUR TOUGH CHEVY PICKUP IS A TRUCK WITHIN A TRUCK.

A Chevy pickup is tough in the right places. With two steel walls in the Fleetside tailgate, body sides, doors, front fenders and hood. Plus extensive rust protection throughout.

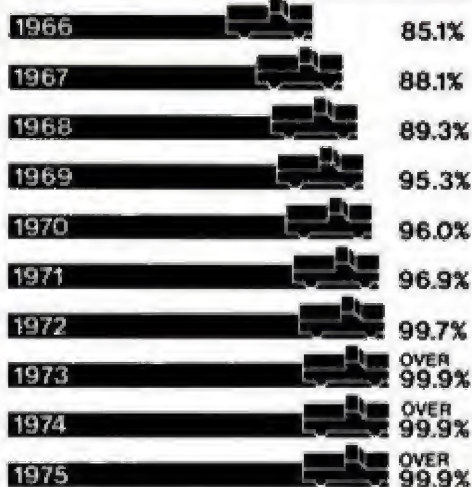


**Cargo box** has a full inner wall of steel extending all the way up the body side on Fleetside pickups. It protects the outer wall from dents.

**Front fenders** have an embossed inner wall of steel under the exterior sheet metal. Plus a self-washing inner fender skirt to help protect engine compartment from salt spray and flying stones.

**Hood** is fabricated from two pieces of steel welded together for rigidity. You also get two walls of steel in the doors, upper cab panel, windshield pillars and front cowl.

**For protection against rust,** inner surfaces of both inner and outer front fenders are sprayed with a zinc-rich primer before assembly and final priming. And pickup box steel floor, sidewalls, front panel and tailgate are totally immersed in an electrically charged primer, drawing paint into seams and crevices for corrosion protection.



Chevy has an impressive record for building trucks that last. The chart above shows the percentage still in use in each of the 10 most recent model years recorded. 96% of all Chevy trucks registered during those model years were still in use on July 1, 1975 as reported by R. L. Polk & Co.



**BUILT TO STAY TOUGH**





TODAY'S FORECAST:

# EARTHQUAKE!

**O**n the western edge of the Mojave Desert, north of Los Angeles, the land is rising like bread dough on a warm radiator. Since 1960 a huge kidney-shaped area of 10,000 square miles has uplifted more than a foot in many places. Scientists of the U.S. Geological Survey are watching the region like hawks.

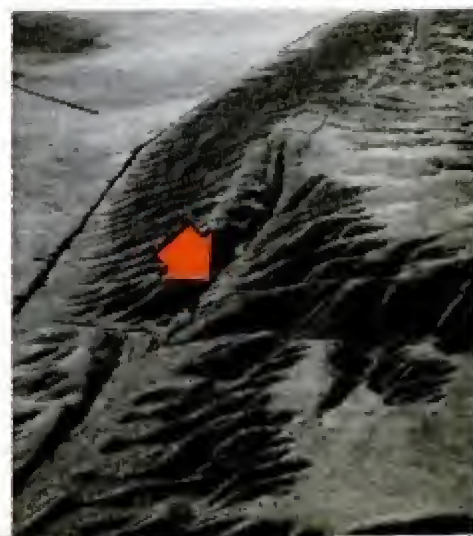
Radio stations in Southern California have even put Bugs Bunny to work warning people what to do when a quake hits. The uplift straddles a sector of the San Andreas Fault that has remained "locked" since the great quake of 1857. Hence, say the experts, strain may be building up in the area.

According to Dr. Robert Hamilton,

Can man  
beat nature's most  
devastating event?  
Scientists say  
quake predictions are  
a realistic goal.

by Richard F. Dempewolff  
and  
Mike McClintock  
HOME AND SHOP EDITOR

When built-up stresses in the San Andreas Fault (arrow) are released, huge manmade structures are shaken to destruction.





chief of the USGS Office of Earthquake Studies, ground swelling preceded a 1971 San Fernando temblor (earthquake tremor) as well as one that shook Niigata, Japan, in 1964.

Geophysicist Dr. Barry Raleigh, at USGS field headquarters in Menlo Park, Calif., adds the historic case of a village on the Japan Sea, where people woke one morning to find that their bay apparently had "gone to sea" overnight. Suspecting the ocean had receded due to an imminent tidal wave from a distant storm or volcanic eruption, everyone made for the hills. Nine hours later a devastating earthquake destroyed their town. The bottom of the bay, which actually had uplifted several meters in 12 hours, subsided again, and the sea rushed back, sweeping everything before it including the villagers who had returned to see what the quake had done to their homes. The notable fact, duly documented, is that a massive uplift preceded the quake.

However, existing records don't prove that *every* earthquake is preceded by uplift. But this phenomenon, along with other activity now known to precede some quakes, soon may tell geophysicists where, when, and how destructively the next big shake-up will occur.

### Prediction progress

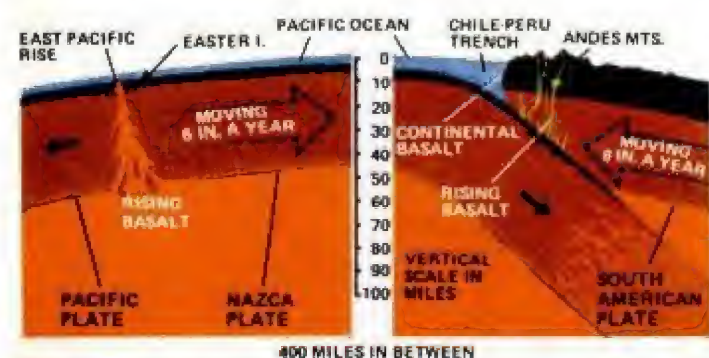
Already, scientists in the United States and elsewhere have predicted with fair accuracy a number of local temblors. In November 1974, geophysicists at Menlo Park had the data to predict a magnitude-5 earthquake near the month's end epicentered at the town of Hollister. On the 28th, a slightly lesser quake struck just south of Hollister. Since the forecast was a test, no public warning was issued.

At Blue Mountain Lake in New York's Adirondacks, in 1973, evidence of a potential quake turned up in velocity patterns of seismic waves propagating through the crust. Other instruments confirmed that something was happening in the bedrock. Dr. Yash Aggarwal, a Lamont-Doherty Geological Observatory scientist, calculated that an earthquake of 2.5 magnitude or greater would hit within four days. A couple of nights later, at dinner, Aggarwal thought he felt a shudder, checked his seismographs and discovered that a 2.6 quake had quivered through the scenic mountain area he'd specified.

And recently, the National Research Council's Panel on Earthquake Prediction ventured an opinion that "a scientific prediction will probably be made within the next five years for an earthquake of magnitude 5 or greater in California."

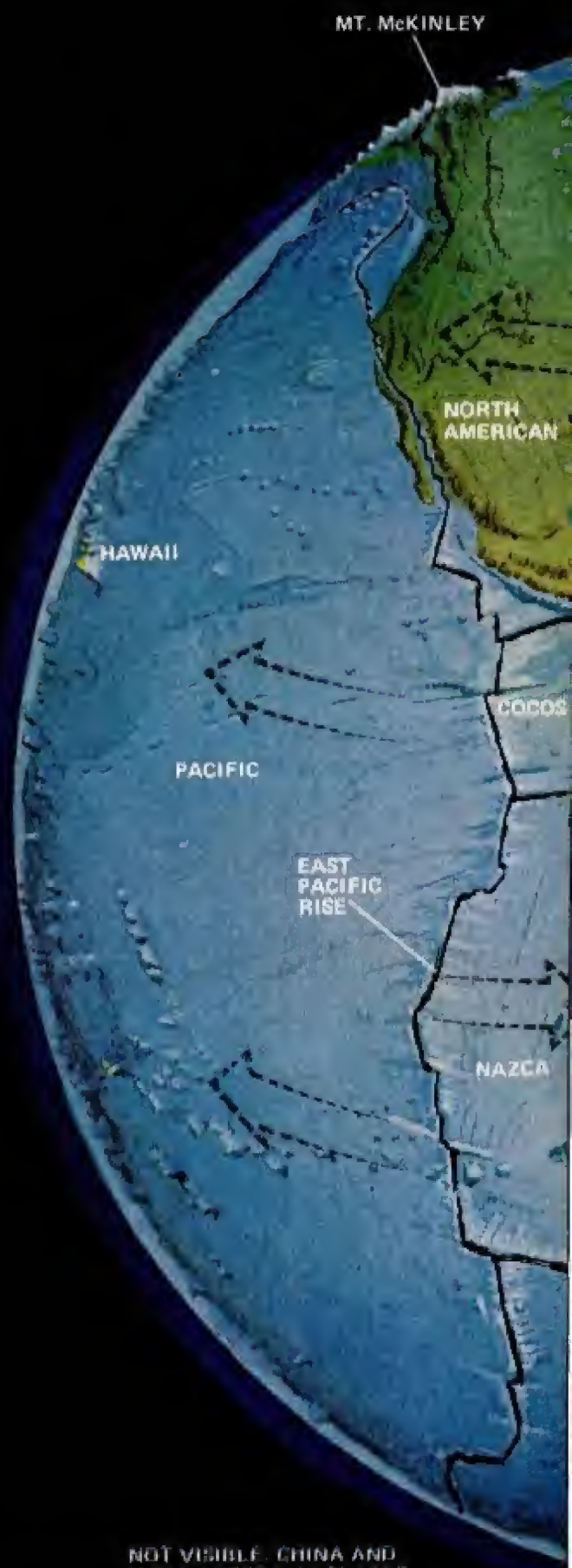
### Life-saving predictions

In China, where 10,000 quake-teams monitor that geologically restless country's quake precursors, more than 10 successful predictions have been made and warnings



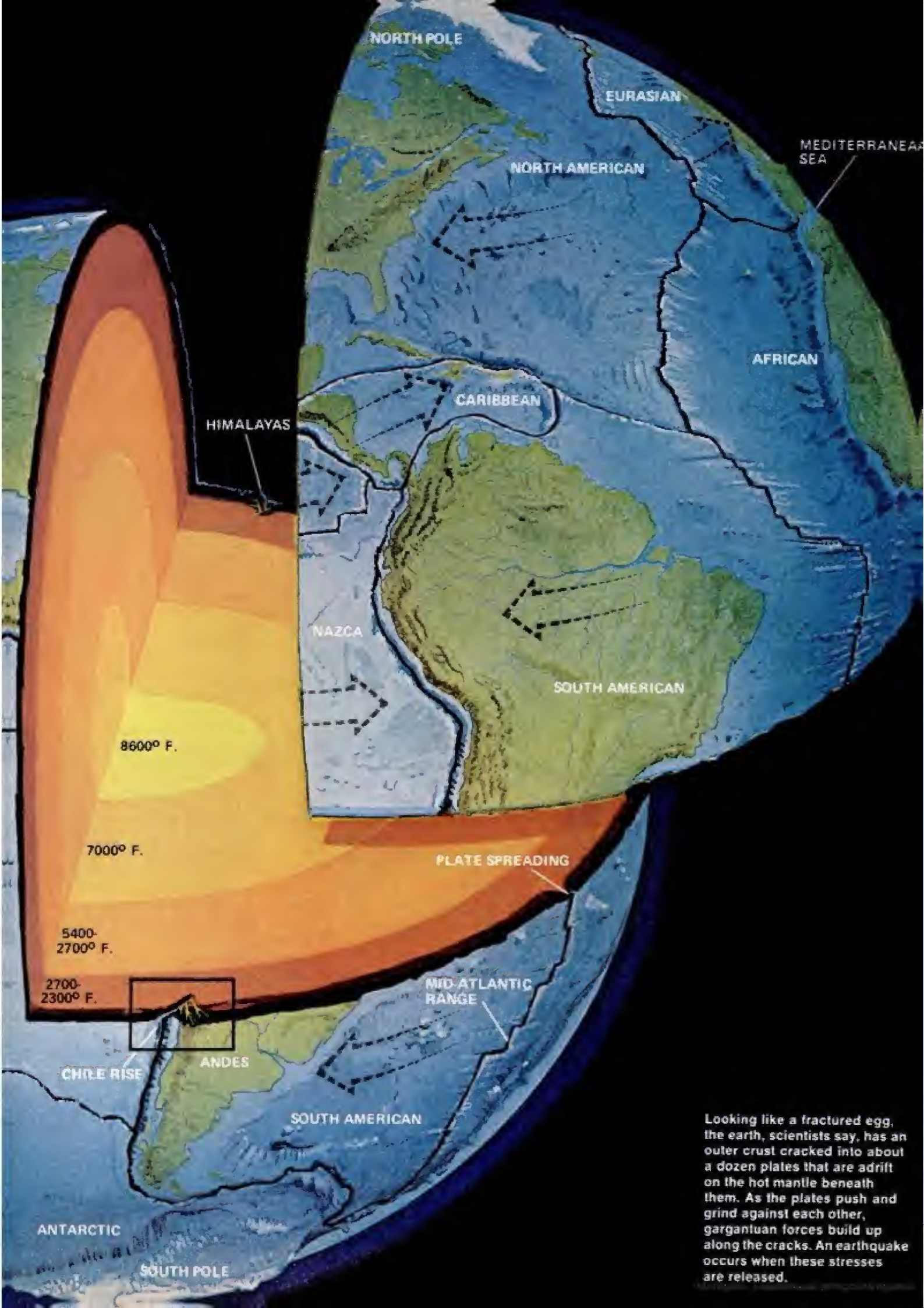
Something's got to give when two plates meet. The inset shows the Nazca plate being bulldozed into the earth's molten core.

# Great plates of the earth



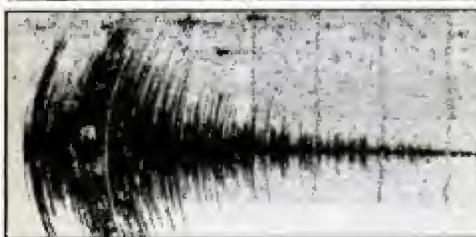
NOT VISIBLE: CHINA AND INDIA AUSTRALIA PLATES





Looking like a fractured egg, the earth, scientists say, has an outer crust cracked into about a dozen plates that are adrift on the hot mantle beneath them. As the plates push and grind against each other, gargantuan forces build up along the cracks. An earthquake occurs when these stresses are released.





Laser ranging devices (right) are part of the new arsenal of earthquake-prediction equipment. They can detect minute changes in land formations. Scientists can "read" quakes on seismometer printouts.



issued. The accurate forecast of a big one recently saved thousands of lives. It began in 1970, when instruments provided a number of clues that crustal changes were occurring around Haicheng on the Liaotung Peninsula in southern Manchuria.

During the next four years, reports of anomalies increased and a 4.8 foreshock hit the region. By February 1975, the scientists were sure; a crash warning was issued predicting a major quake within two days. An hour later, tens of thousands of people were moving from their homes, carrying the old and sick to places of safety outdoors. In some villages, officials showed outdoor movies to coax out those reluctant to leave. Less than six hours after the alert, a 7.3-magnitude earth-shaker brought down virtually every building in Haicheng, but casualties were light.

With such success, what happened at Tientsin, Tangshan and Peking last July? Reuters news service estimated that up to 800,000 people perished in that immense 8.2 quake—which would make it the second worst in recorded history. (An 8.5 shake-up in Shensi, China, took 830,000 lives in 1566). Actually, China's earthquake team had forecast last July's quake. Ominous magnetic changes had been noted, along with other precursors. Last year, radio stations began to warn the teeming populace of affected cities to prepare for a great earthquake. Whether or not a last-minute alert went out is not known.

#### Earth like a cracked egg

Only for the past decade have geophysicists known enough about the staggering forces that cause earthquakes to do much about them. The opportunity for predicting them

began with the astonishing discovery that the earth's surface is not one continuous sheath like the glaze on a candied apple. Our continents and ocean basins are adrift on the hot plastic mantle underlying them. According to this new view, called "plate tectonics," the earth's 30-to-60-mile-thick global crust is fractured, like the cracked shell of an egg. As researchers probe deeper into the ocean-bottom trenches and continental land masses that cut into the crust, they begin to see a world in which those vast sections of thick crust are in constant, thrusting, dynamic motion.

Evidence in the deep-drill cores brought up by scientific teams indicates that for more than 4 million years, those gigantic plates have been jostling and grinding their rock-faced edges against each other—separating to create oceans, squeezing shut with crumbling pressure, overriding each other like ice floes on a polar sea—driven slowly but inexorably by gargantuan forces deep in the earth's molten interior.

#### Unraveling nature's secrets

This exciting concept provides elegant answers for many geological mysteries that have plagued scientists for centuries. It explains the jumbled formation of our jagged coastal sierras; what sea-bottom fossils are doing in rocks on Everest's peak; why volcanic archipelagos stream across the ocean floors in continuous chains; how the fossilized remains of an African reptile turned up in sedimentary rock layers of Antarctica. It also explains the strange, cloven structure of submarine mountain ranges and provides the long-sought primeval mechanics of volcanoes and earthquakes. The plate concept holds that:

■ The earth's crust is made up of about a dozen major plates, with many fractures and subdivisions.

■ The present land masses, embedded in crustal basement rock, once formed a single continent that began splitting up about 200 million years ago. For years, school kids have noticed that many continental shorelines "match" but scientists have been hard-put to explain this "coincidence." The plate theory does it neatly. It proposes that molten material from the earth's hot mantle forced its way through rifts in the sea floors, hardening against each side and forcing them apart at a rate of one-half to three inches a year. Plates thus formed moved off, carrying continental land masses with them like flotsam frozen in vast ice sheets, eventually rafting them to their present locations.

#### Something has to give

■ As volume is added to the crust by molten rock welling up through those mid-ocean ridges, something has to give—and does. Plates are squeezed by immense forces, with spectacular results. Over the eons, edges crumble into gigantic blocks. They fold and rumple like rug edges shoved together. The lighter sedimentary and granitic rock of the continental plate may grind over the top of the ocean-bottom plate of heavier basalt, bulldozing sediments and rock debris, piling it in a massive jumble of coastal mountain ranges.

The overridden plate presses downward, forming deep trenches like the Marianas and Puerto Rico deeps, as it is thrust down into the hot mantle where it returns to a molten state, completing the cycle. In the grinding process, pockets of white-hot lava may be trapped, eventually



pluming through fissures to the surface and erupting in volcanoes.

■ As a plate inches along over such a volcanic fissure, the plume of magma punches hole after hole through the crust in a sort of belt-line production of volcanic islands such as those in the Hawaiian chain.

■ Deep earthquakes that shake the entire planet, pinpointed by seismographs at depths down to 400 miles in the ocean trench regions, are thought to be the rumblings of that thrusting, elephantine digestive system of overriding plates. Catastrophic surface quakes, like those along California's San Andreas Fault and the Altyn Tayh Fault in China, are the result of plate edges shearing and grinding as they slip after years of remaining "locked."

### Signs quake-watchers look for

Now, with a whole new body of knowledge pouring in from the field, geophysicists are finding ways to measure and evaluate the events that precede earthquakes. In more than 25 cases, Menlo Park instruments have picked up precursory anomalies of quakes that occurred. In 10 other cases, however, the quake didn't ensue. Dr. Raleigh indicates that's not good enough. For prediction to work, he points out, forecasts must meet all criteria, including:

- Accurate location of the epicenter.
- Calling intensity within a few



Fenced-in property lines get lost in the shuffle when an earthquake rumbles by. Where fault lines run through populated areas, sudden quakes can be catastrophic.

tenths on the 1-to-10 Richter scale.

■ Naming the day and approximate time the quake will hit.

■ Providing a long-range prediction to allow for preparation, as well as a flash warning within a few days of the expected event.

To achieve such accuracy, a battery of techniques—some new, some old—is being brought to bear.

In repeated observations, it has become apparent that swelling of land prior to many quakes involves the appearance of myriad "micro-cracks" in the rock—a phenomenon called "dilatancy" caused by stresses.

### New tipoffs to coming quakes

The Russians discovered that speed of seismic waves in bedrock often slows long before a quake, increasing

again just before it occurs. Today, along the San Andreas Fault, dozens of seismometers monitor seismic velocities in the ground by measuring waves from quarry blasts. "According to the Russians," says Raleigh, "the time scale in which the decrease and rise occur is proportional to the quake that hits."

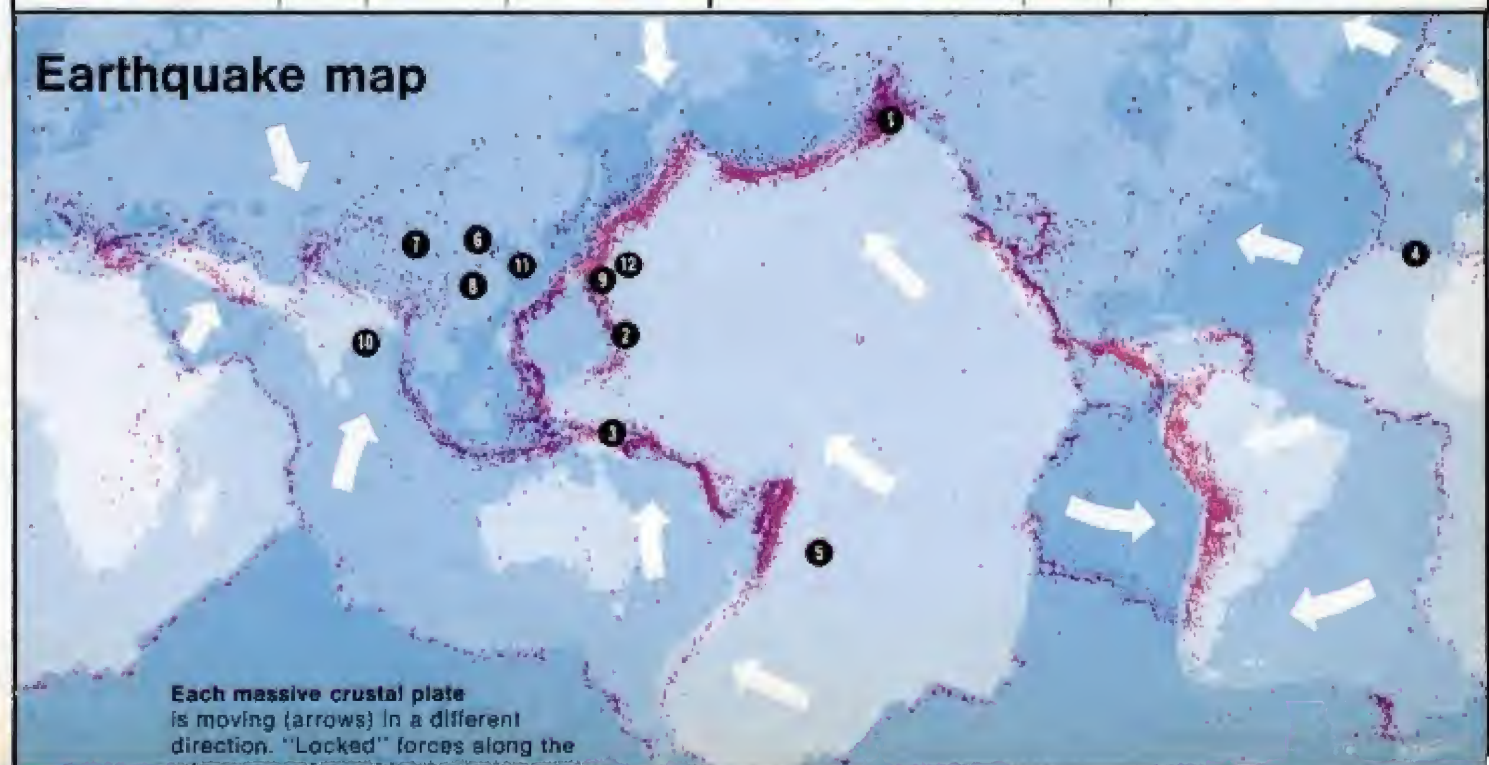
At Stanford University, geophysicist Dr. Amos Nur discovered that during dilatancy, ground water fills the microcracks, probably causing the decrease in seismic velocity, as well as other curious phenomena, including changes in the level of well water. "Groundwater," explains the Office of Earthquake Studies' Dr. Joseph Ziony, "seeps into cracks of rock under stress and you get a drop in well levels. As voids are filled, the level comes back." In the stresses just preceding a quake, cracks close, sending water up dramatically.

The Chinese, for instance, observed that just prior to a quake ordinary wells sometimes went "artesian," flowing out over the surface.

In China, where Dr. Raleigh and other geophysicists saw thousands of volunteers and scientists at work in 1974, and again last summer, interesting approaches are afoot. "Amateurs monitor wells, plus pairs of electrodes that they poke in the ground 100 feet apart to measure

(Please turn to page 131)

BIGGEST QUAKES IN RECENT YEARS				QUAKES CAUSING THE MOST CASUALTIES		
Place	Year	Richter No.	Casualties	Place	Year	Casualties
1. Anchorage, Alaska	1964	8.5	131	1. Chihli, China	1290	100,000
2. Philippine Sea	1968	8.0	None	2. Shensi, China	1556	830,000
3. New Guinea	1971	8.0	None	3. Tokyo, Japan	1703	200,000
4. North Atlantic	1975	8.0	None	4. Calcutta, India	1737	300,000
5. Off Kermadec I., N.Z.	1976	8.0	None	5. Kansu, China	1920	180,000
6. Near Tientsin, China	1976	8.2	600,000-800,000 (Reuters est.)	6. Yokohama, Japan	1923	143,000
				7. Near Tientsin, China	1976	600,000-800,000 (Reuters est.)





# A hot plane gets its sea legs

by John F. Pearson SCIENCE EDITOR



The F-14's engines are wide open as it slams into the deck with an 80-ton impact. If the tail hook doesn't catch an arrestment cable, the fighter must bounce off and climb for another go-around.

The *John F. Kennedy* carries two F-14 squadrons—the VF-14 Top Hatters (plane in foreground) and the VF-32 Swordsmen. The Swordsmen fighter, its tail hook still gripping a cable, has just landed.





Fitting a new plane like the F-14 Tomcat into carrier operations is an exhausting process. But the work pays off. In a NATO exercise, the Tomcat clearly ruled the sky.

It's easy to describe the *John F. Kennedy* in terms of numbers. The 83,000-ton carrier is 1051 feet long, has a 4.53-acre flight deck, four catapults and normally carries 95 planes. But a more meaningful description is encapsulated in one word: Power.

When the ship is under way, you sense the enormous power of engines that can push this floating airfield, this seagoing city of 5000, at speeds of better than 30 knots.

Stand on a catwalk aft, with your eyes almost at flight-deck level, and you're assaulted by the force of a 40,000-pound F-14 slamming to the deck with an 80-ton impact, its wheels kicking up grit and puffs of smoke as the arrestment cable hauls it to a stop.

Or kneel with a launching officer between the two forward catapults. At the officer's two-finger signal, the pilot runs up the twin engines of an F-14. Then the officer's hand snaps down. Engines roar. The steam-driven catapult whooshes. From a standing start, the plane is shot to 160 mph in 2.5 seconds. You turn to watch the aircraft climb,

and you're hit by waves of heat.

I was aboard the *Kennedy* recently to observe flight training. I was especially interested in the F-14 Tomcat, the replacement for the F-4 Phantom, a fighter dating back to the mid-'50s. Two squadrons of Tomcats—the planes of the VF-14 "Tophatters" and the VF-32 "Swordsmen"—were initially flown aboard the *Kennedy* in March 1975, following land-based training.

In NATO exercises in the Mediterranean later in '75, the "enemy" launched 91 flights against the *Kennedy*, but not one was able to penetrate the carrier's air defenses.

### Hawkeyes and Tomcats teamed

Navy brass credited much of this achievement to the teaming up of the E-2C Hawkeye—an early-warning and command aircraft loaded with electronics—and the F-14. The NATO exercises marked the first time that Hawkeyes and F-14s—both produced by Grumman, a builder of many Navy planes—were operated from the same ship.

Just how well the combination works—and how well the F-14 per-

forms—was recounted for me in the Swordsmen's briefing room by Lt. Jim Aldrich, a pilot, and Lt. C.W. Hoffman, a Naval Flight Officer (NFO). Jim Aldrich was on patrol when a target was picked up and vectored—it was coming in low, barely 50 feet off the water. Aldrich dropped down and headed for the adversary. He intercepted the plane, a Mirage, "shooting" it with an on-board camera for a "kill."

The French plane made a tight turn and poured on the power in a steep climb—only to find, seconds later, the F-14 threatening to fly up his tailpipe. That was enough for the French pilot, who headed for home.

"With this plane you can make magic moves," said Aldrich, grinning. "That's what so intriguing about it. You're flying a different plane at different altitudes and speeds."

The Tomcat's variable-geometry wing is controlled by a computer that positions it for top performance at a given speed and altitude—a big plus in dogfighting. The plane has a top speed of over Mach 2 and a ceiling of almost 70,000 feet.

"The F-14 is unlike any plane ever built," observed Hoffman. "It has an exceptional airframe coupled with a unique weapons system."

The Hughes AWG-9 weapons system uses radar and an infrared

(Please turn to page 132)

An A-6 Intruder, an all-weather attack plane (below), is shot from steam-driven forward "cat." In 2.5 seconds, the plane hits 160 mph. Any doubt about who's Air Boss on the *John F. Kennedy* is eliminated by the stenciling on Cmdr. John (Dutch) Schultz's sweatshirt (far right). Author (right, with camera) is briefed on safety. On flight deck, protective gear is a must.



Navy photos: PH2 C.W. Roberts







Dodge Adventurer



Chevrolet Silverado



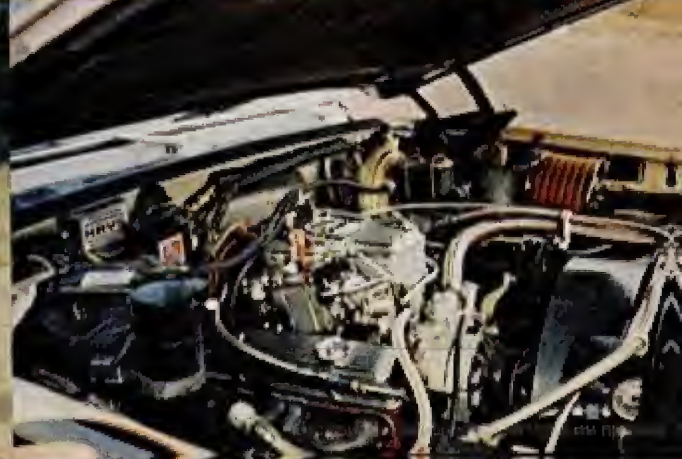
GMC Fenderside



Ford Ranger



Oldsmobile Cutlass





# Behold, the pickup truck!

There's a whole lot of hauling going on—pickup trucks are the hot setup these days. Here's a look at some of the custom rigs and a rundown of the showroom stock pickups on the market.

by Wallace Alfred Wyss

**A** lot of new pickups are going out the door at 10 grand. How can a pickup truck that only lists for \$4500 go for \$10,000? Simple. A pickup in its raw, unoptioned form is really not very useful for much besides street driving and moving light loads. As soon as you want to apply it to a special purpose—to haul a boat or trailer, or to go off-road—you've got to have special accessories that'll allow you to do the job right.

The West Coast is where most U.S. automotive trends—from customizing to drag racing—got their start. A host of specialists have predictably popped up to service the latest trend—the booming pickup truck market.

Some are dealers like Fairway Ford in Placentia, Orange County, Calif., where the owner, Dick Landfield, races pickups himself and knows what's needed. Others are independent hop-up artists like Vic Hickey of Ventura, Calif., who once designed off-road vehicles for General Motors and now builds the toughest Chevy trucks in off-roading.

To find out what options are popular, we roamed Los Angeles and Orange County to see what a fully loaded truck costs. We found that

\$1000 for just wheels and tires isn't a surprising figure, and that the hot-rod trend of pearlescent paint and pinstriping didn't die with '32 Fords; it's just resurfaced with pickup trucks, the '70s' "hot rods."

## Four-wheel drive

Beyond a doubt the biggest dollar option is four-wheel drive. No option is more useful once you get off paved road. But you pay for it in uncomfotableness on paved road, even when you can switch out of it into two-wheel drive. Ordering the four-wheel-drive option puts your truck higher into the air, making it harder to get into and out of. Some pickups have what's called "full-time four-

wheel drive"—you are in the four-wheel-drive mode all the time. The older and more common system requires you to switch the front hubs into the four-wheel-drive mode before the front wheels start pulling.

One should think hard before spending \$1000 plus on four-wheel drive for your pickup. Do you really need it? Or is it only the last quarter mile to your cottage that's unpaved? A set of knobby tires on your two-wheel-drive pickup might get you across the same terrain a lot cheaper.

Four-wheel drive is ordered by most off-roaders, and it usually raises the whole rig off the road high enough to make skid plates unnecessary. But—to be on the safe side if

**Rich-looking pickups** are fairly rich in price. Dodge rig at left, for example, goes for \$9000. The custom, four-wheel drive Chevrolet Silverado lists for a little over \$8000, but set up as shown at left, with add-on parts and labor, stickers at \$13,500! The Ford F-250 Custom Styleside pickup shown at right and on the cover is a \$5000 truck stripped, but can be yours with 4WD and lots of flash for \$9000.





the terrain you travel has sharp-edged boulders—skid plates are a wise investment. A complete set on a 4WD truck covers the front oil pump, transfer case and differential. You can order them in bolt-on form for most rigs, making welding unnecessary. You want them unboltable for easy access to the mechanicals.

A 6000-pound truck can be made to handle—after a fashion—and Hellwig, an old name in suspension additions, makes heavy-duty coil and leaf springs and sway bars for trucks. The sway bars should be called “anti-sway” bars, for their effect is to minimize body lean during corner-



Old pickup trucks like this '50 Chevy are also getting the custom treatment.

ing. Most Detroit handling kits for cars use front and rear sway bars, so these are merely upscaled units.

There are several schools of thought on shocks. One is: If one is good, two are better. Therefore, dual shock mounts (about \$30) are sold for many trucks. With two shocks per wheel, adherents of this school feel, you're in better shape coming off the big “yumps.”

A second school believes in air bags—air-filled rubber bladders that tuck inside the coil springs or between the rear leaves and supporting frame. Both these and the air shocks require periodic refilling unless you've augmented the latter with an on-board compressor.

### Beefed-up shocks

Dick Landfield went to Bilstein, the German firm that builds the standard-equipment shocks for Mercedes, and had it design a shock for Ford Broncos and half-ton Ford pickups. The Bilsteins are filled with nitrogen gas and, even after repeated use, the gas won't lose its damping effect like the oil in a hydraulic shock does when it gets hot. Although Bilsteins cost roughly \$62 a pair, they can carry a truck through a whole season of rough off-roading where an ordinary shock would require replacement every few weeks (or in races, every race).

Tires and wheels are also a subject of endless debate. Almost nobody who orders a truck keeps the stock wheel rims on it, because they simply

aren't wide enough to carry most of the wide rubber needed for off-road or heavy-duty conditions.

You have to weigh your tire choice carefully against the conditions you're going to use them for. What's more important to you? Traction? Flotation? Highway noise? Many neophyte truck owners buy the biggest stagger-block knobbies they can only to find themselves using their truck almost exclusively in street driving—where the knobbies turn out to be rough-riding, hard to control and lacking in traction. But trying to run narrower street tires with a filled-out tread pattern off the road can get you stuck in a hurry.

One of the troubles of driving in rough terrain with the big knobbies is that you get excessive feedback from the steering—every bump you encounter jerks the steering wheel and threatens to snap your wrist. To dampen this overreaction, Heco and other firms make a steering stabilizer that works like a shock absorber, dampening out vibration.

Few so-called “mag” wheels are lightweight magnesium (where the nickname came from). They're actually aluminum so they still reduce unsprung weight slightly. But when the tires weigh 20 pounds or more, saving a few pounds per wheel over steel wheels might not be worth the extra price of aluminum spokes.

### Buyers choose automatics

Stick shifts are rarely ordered on pickups today. Automatics have proven themselves, especially in trailer towing—but they're not perfect.

B & M Auto Products, a California company that first made its name in building bulletproof drag-racing transmissions, has found off-roaders and truckers a big market. It has developed a whole raft of modifications for the stock automatics used in pickup trucks, which are prone to slippage due to heat buildup when used hard. B & M (9152 Independent Ave., Chatsworth, Calif. 91311) recommended a transmission oil cooler as a first step, but also sells such things as a Shift Improver Kit that replaces a transmission part with their own, resulting in less slippage. Another bolt-on is a cast alloy pan for the transmission that has cooling fins cast into it.

B & M also sells a “Gravel Grabber” torque converter that borrows a trick from its drag-racing experience where they found a higher initial stall speed delivered more power “off the line.” The same goes for off-road truckers who want all the power they can get to be applied as soon as they floor it in Drive.

Engine modifications would greatly improve the performance of today's smog-controlled V8s, but most dealers won't touch an engine because of EPA restrictions.

### Watch out for the law

Although emissions laws in most states, especially in California, forbid modification of the carburetion or exhaust system, that doesn't stop many truck owners from installing dual exhausts after accepting delivery to replace the factory single exhaust, upping horsepower about 5 percent. Custom headers are more likely to attract a citation because of the noise, but they increase horsepower at least another 5 percent, and when you're towing a boat or trailer, you need every horse you can get.

A heavy-duty generator, heavy-duty alternator and heavy-duty battery are also recommended purchases when you buy your truck. Even if you don't envision a use for them now, who knows what bug you'll be smitten with next—hauling a boat or a six-pack camper? It could cost a bundle later to reequip your engine room to cope with new demands.

Somehow, pickups as pretty as the ones on these pages don't stay that way for long. Folks have a way of trying to outdo Army tanks in them. That's why popular bolt-ons include



Lightweight pickups like this Ford Courier are getting the trick look, too.

various types of guards.

Running off-road means you sometimes encounter wayward stumps that can puncture a grille and radiator. A popular option to defend against this danger is a front grille guard, usually consisting of three steel tubes about 2 inches in diameter connected to two curved brackets that swing upward from under the bumper. These run about \$60 in black finish or chrome.

If your plans call for even more bashing through underbrush, several firms sell a grille and light protector bar that surrounds the headlamps and wards off limbs that might smash them.

### Roll bars for pickups

And then there's the danger of rollover . . . How can anything as

(Please turn to page 146)



# Over-the-counter pickups

If you're not quite ready to join California's custom stepside revolution, here's what's available in the way of ready-made 1977 pickups from Detroit and Japan.

## AMC Jeep J-10 and J-20

AMC's 1977 Jeep pickups boast 4WD, a more powerful basic Six, and power front disc brakes as standard equipment.



Jeep Honcho

The spunky Honcho package continues in the J-10 series.

Jeep pickups come on two wheelbases—119 and 131 inches. The 131-inch wheelbase is available in both Jeep pickup series (J-10 and J-20). GVW ratings are considerably higher in the J-20, and the 260-c.i.d. V8 becomes standard J-20 equipment—as against the J-10's 258-c.i.d. standard Six.

All J-10s now have heavier front axle tubes, and revised seats. Both the J-10 and J-20 use Dana's manual 4WD system, with Quadra-Trac, automatic trans, four-speed, and the 401 V8 available.

## Chevy C and K-Series pickups

Chevrolet's 1977 pickups include eight new 4WD models in the Series K30 one-tonners. That's in addition to bolder restyled front ends and a raft of new options and refinements in 2WD C and 4WD K-Series full-sized Chevy pickups.



Chevy Cheyenne

Chevrolet's K30s come in three wheelbase lengths and carry both two and four-door cabs (standard, crew and bonus). The K30s use a 4500-pound front-drive axle, while the K20 ¾-tonners have 3800-pound front axles.

Standard power for most 1977 Chevy pickups comes from 250 and 292-c.i.d. Sixes, with 305, 350, 400 and 454-c.i.d. V8s optional. Power door locks, power windows, inside hood release, styled spoke wheels, "pulse" intermittent wipers, and lots of bright paint and trim treatments highlight Chevrolet's 1977 offerings.

The 1977 El Camino takes on a face-

lift, and the Luv, which was revised in mid-1976, stays pat.

## Datsun 620 pickup

No major changes in Datsun's normal and long-bed series—same specs throughout as for 1976. However, five-speed overdrive transmissions are now available in all 1977 Datsun pickups.

## Dodge D and W-Series pickups

The Warlock, a factory-supplied stepside in the California vein, leads Dodge's parade of 1977 pickups. The Warlock uses Dodge's 318 V8 and oozes goodies above and beyond the skin: special paint and striping, sideboards, chrome steps, hero wheel, bucket seats and more.

Other Dodge pickup trim levels are called Custom, Adventurer and Adven-



Dodge Warlock

turer SE. Wheelbase range from 115 to 165 inches and include a large array of cabs and boxes.

Base D-100 engine remains the 225-c.i.d. Slant Six, up 10 bhp from 1976. You can also order V8s in 318, 360, 400 and 440 displacements. There's a four-speed overdrive manual trans, plus 4WD in W-Series Power Wagons and an automatic. Payload ratings go from 1390 pounds in the D-100 through 5445 pounds in the W-300.

## Ford Ranchero, F-Series, Courier

The Ranchero gets all-new sheet metal for 1977, including a bolder grille and stacked rectangular headlamps. Available in GT, Squire and Ranchero 500 versions, Ford's 302 V8 becomes standard here.

The F-Series Ford pickups get full-time 4WD optionally (F-100-250), with part-time 4WD becoming standard with automatic transmissions. Base F-Series engine is the 300-c.i.d. Six, and 351 and 400-c.i.d. V8s replace the previous 360 and 390.

Crew four-door cabs and "super" cabs with center-facing jump seats are available again this season. F-Series improvements include more extensive rust protection via plastic fender liners and galvanized body components, an optional speed control available with V8s, electric rear-window defroster, a new spare-tire lock, six new exterior colors, plus a wider choice of axle ratios for economy and high altitude.

The 1977 Courier pickups will make their debut in January. They're reported to be different from 1976 models, but

details aren't available at press time. The Courier, built by Mazda, will likely reflect Mazda's 1977 changes.

## GMC C and K-Series pickups

Most details of GMC's 1977 pickups parallel those of Chevrolet. GMC's C-Series are 2WD, while 4WD's make up the K-Series.

Base engines are the 250-c.i.d. Six in the 1500s; 292 Six in 2500 and 3500. There are optional V8s of 305, 350, 400 and 454 c.i.d. Available transmissions in-



GMC Sierra Classic

clude three and four-speed manuals plus Turbo Hydra-Matic.

Accessories reflect Chevrolet's, as does GMC's major front-end facelift. The 1977 GMC Sprint again shares nearly everything with Chevrolet's El Camino.

## International Scout Terra

International continues with only one pickup for 1977—the Scout Terra. This half-tonner shares the Traveler's 118-inch wheelbase, has a 2400-pound payload rating, carries a 6-foot bed plus 11 cubic feet of storage space behind the seat.

In addition to the standard 196-c.i.d. Four, you can choose between 304 and 345 V8s, plus the six-cylinder Nissan diesel (92 bhp). Standard Terra equip-



International Scout Terra

ment includes power disc brakes, manual locking hubs, tinted glass, and ½-½-spill front seats. Among the Terra's options are selective 4WD, cruise control and various trim packages.

## Mazda B-1600 and Rotary pickups

Mazda, along with Ford's Courier, promises some sweeping 1977 changes but won't divulge them until formal introduction early next year.

## Toyota pickups

Toyota pickups for 1977 remain unchanged in every respect but one. The five-speed overdrive transmission is now available in Toyota's standard-bed 1977 pickups.—Mike Lamm





# Fire alarm: New home appliance that may save your life

by Mort Schultz



**L**ast June in Fairfax, Va., smoke from a smoldering fire caused a family of five to suffocate as they slept in their expensive two-story home.

Commenting on the tragedy, Fairfax assistant fire chief William Bittle said, "It doesn't seem right spending \$80,000 on a house, but not \$50 for safety."

The \$50 Chief Bittle was referring to would have bought the family an automatic warning device that would have sounded an alarm moments after the fire started, awakening them and giving them time for escape.

In Freehold Township, N.J., not long ago a 15-year-old boy and his grandmother perished when fire swept a two-story home during the night. The boy died in a leap from a second-story window trying to escape. The woman was asphyxiated by smoke.

"There is no doubt in my mind that if there had been a fire or smoke detection device in the home we could have possibly saved the lives of two people," Fire Marshal Frank Wilgus says.

## 300 fires an hour

The dramas in Fairfax and Freehold are duplicated every day of the week. According to the National Commission on Fire Prevention and Control, statistically there is the likelihood that nationally within the next hour 300 fires will break out. This figure translates into a mind-boggling 2,628,000 fires a year.

The Commission reports that annually in this country alone fire kills 12,000—more than 6000 of them in home fires—injures 300,000 and destroys \$11 billion in property.

Every day one fire official or another is reminding us that this

**Smoke detectors** warn of fire before heat and flames build up, give vital extra seconds to get safely out of house. At upper left is ceiling-mounted Honeywell. Below, Gillette photoelectric model is available in battery or plug-in version.







**Two basic types** of smoke detectors are diagrammed in simplified form at right. In photoelectric alarm, small light beam, constantly on, shines across a darkened chamber. If fire occurs, smoke particles enter the chamber, act as tiny reflectors and divert part of the light to photocell detector. Photocell senses the light and sounds an alarm. In ionization detector, ionized air molecules gravitate toward oppositely charged electrodes, setting up tiny current flow. Entering smoke particles slow the ion flow, producing a current drop that triggers the alarm.

Many detectors come in choice of battery or plug-in operation such as GE model shown here and Gillette unit on facing page. Battery-powered type is handy for ceiling mounting, as above, where no power source may be near or you don't want power cord to show. If you choose plug-in type, be sure outlet used is not switch-controlled to avoid accidental shutoff of power. Battery models require weak-battery warning indicator.

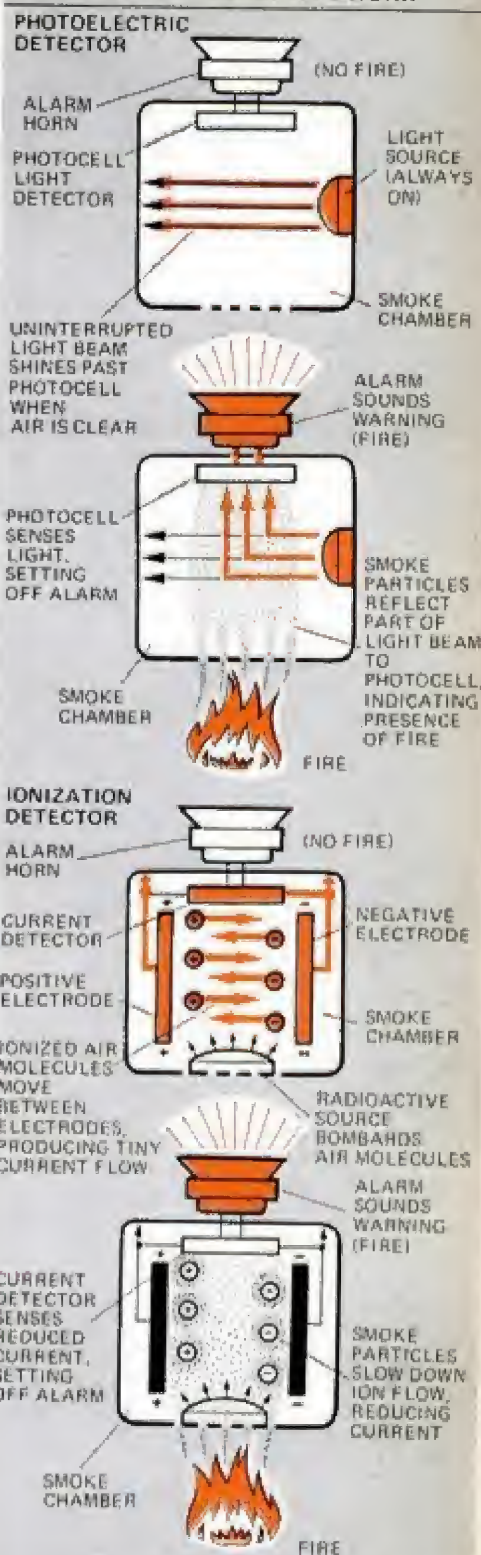


Early-warning smoke detectors offer inexpensive protection, and are fast becoming a household safeguard. Here's what you should know about them.



**Installation is easy**, as typified by this Honeywell mounting sequence. Base plate is first screwed to wall or ceiling (upper left), then sensor unit is attached to the plate (upper right). Cover is snapped on (lower left) and job is done. Alarms are best located high on wall or ceiling as smoke rises. Good spots are hallways and stairs with at least one unit per floor level recommended.

#### HOW THE TWO BASIC TYPES OF SMOKE DETECTORS WORK



PM art: Peter Trojan

terrible toll in lives and suffering could be substantially reduced if homeowners planned for fire as carefully as most do, say, for vacation.

But most people don't. Fewer than two million of the nation's 70 million residences are presently equipped with fire-detection devices. This is particularly tragic when you realize that 9 out of 10 deaths from fire occur at home, but that an estimated 8 of every 10 of them could be saved if homes were equipped with detection alarms.

Joe Erdmann and his wife and



daughter today swear they owe their lives to such a device. It was a year ago on Dec. 23, 1975, at about 2 a.m. when Erdmann was awakened abruptly by a raucous blast from the smoke detector outside the bedroom area in his Neenah, Wis., home.

A wisp of smoke from a fire smoldering in the kitchen had set off the alarm, giving Erdmann time to evacuate his family and extinguish the flames. "Thanks to that smoke alarm we were able to save our lives and our home," he says.

The two basic types of home fire

detectors are smoke and heat. A smoke detector detects particles of combustion. A heat detector detects high temperature or a high rate-of-temperature rise.

### Inexpensive protection

When activated, both types emit a leather-lunged horn blast of at least 80 decibels for at least four minutes that will arouse the soundest sleeper.

Some fire experts suggest a system combining both heat and smoke detectors where maximum protection is desired and cost is no object. How-

## Know your fire extinguisher

Underwriters Laboratories puts fire extinguishers through sheer torture. Before one can obtain a UL listing, it is dropped on concrete, soaked in saltwater, frozen to minus 40°F., heated to 120°, shaken violently, overpacked—then expected to operate perfectly. After tests like these, what could possibly go wrong with your extinguisher? The answer is: Not much—provided you understand and maintain it properly. Here are helpful hints on good care and handling:

- Remember that the average small home extinguisher lasts only 8 to 10 seconds. Don't expect it to fight fires beyond its—and your—capacity.
- Check mounting height. The top of your extinguisher should be no more than five feet above the floor for easy reaching. Place it in plain view, near room exits and away from fire-prone areas such as a kitchen stove or paint shelf.
- If your extinguisher has a pressure gauge, tap the gauge periodically to be sure the needle isn't stuck. If the needle moves, the reading is likely accurate.
- Check the tank and nozzle every six months. Metal surfaces should be free from corrosion and the hose clear of any dirt or debris that might clog it.
- Make sure the seal on the trigger safety pin remains unbroken so you can be certain the extinguisher has not been discharged. If the pin has been pulled, assume the unit has been used (unless a gauge indicates otherwise).
- Recharge your extinguisher immediately after use, even if it's only partly discharged. This is the only way of being sure you'll have a full charge when you need it. And it's especially important on dry-chemical extinguishers. The reason: Once the extinguisher valve is opened, even if only for a second, chemical powder particles lodge in the valve seat, preventing the valve from fully closing. In time, the propellant gas slowly leaks out, leaving the unit useless. For this reason, never test an extinguisher by trying it—it may check out fine on the first spurt, then be completely dead when you really need it.
- Recharge only at a recognized extinguisher service center (you'll find them listed in the classified of your area directory, or your local fire department may recommend one). Finding a reliable serviceman is important. Filling an extinguisher with the wrong kind of chemical can cause blockages, and overfilling can result in loss of efficiency. A typical recharge job on a 2½-pounder—a common size many homeowners have—will cost under \$5.
- If you have a CO<sub>2</sub> extinguisher, check its weight regularly against the weight listed on the tank. Loss of weight signals leaking gas—time for a recharge.
- Soda-acid extinguishers haven't been sold for years, but there are still some around. If you have one, be very wary of it. An old corroded tank could blow up like a bomb when activated (see text for safe disposal procedure).
- If you carry an extinguisher in your car, mount it in a bracket under the dash. Don't store it in the trunk where high temperatures could damage it or it could become inaccessible in a rear-end collision.—Gurney Williams III

**Easy-to-handle** all-purpose extinguishers like this BernzOmatic are handy for home use, especially in kitchen, shop and garage. Keep in mind, though, that small types typically last only eight to 10 seconds.



**Portable fire ladders** can offer emergency escape route from upper-floor windows. Most hook over sill or lock across window frame, can be rolled up and stored in a closet. They should not be counted on for use by the elderly or infirm, however.

ever, many now feel that the newer, more sensitive smoke detector that does not require heat buildup to function offers early-warning protection at a modest price—and should become just as common a household appliance as a toaster, food mixer or hair dryer.

For the average home, an elaborate setup is not needed. The National Fire Protection Assn. advises that "some very real protection is possible with one smoke detector on each floor or one smoke detector placed between the bedroom and the rest of the house."

### Smoke sensors work far away

The most important necessity when fire starts is to give a home's occupants ample warning of danger so they can escape. Smoke detectors do this.

"Smoke detectors by their very na-

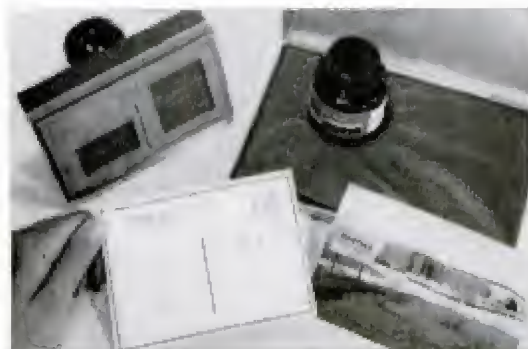
*(Please turn to page 160)*



# IT'S NEW NOW

## Cyclists' radio-intercom

Tandem-riding motorcyclists can listen to radio programs when they're not chatting back and forth over a new "Bicom" that adds optional AM/FM radio to an intercom system. A sound tube attachment connects the intercom to a radio speaker for reception, but still operates as an intercom for double riders. A single rider can also use the radio part of the system. Complete system is \$30; intercom plus a connector for your own radio is \$13. Acoustical Systems, Box 66899, Scotts Valley, Calif. 95056.



## Make your own photo-postcards

Snapshots of the kids, house or a view, printed on 3½ x 5-inch double-weight paper, become personal postcards when hand-stamped on the back for message and address. Stamper, pad and ink cost \$21.40 from Porter's Camera, Box 628, Cedar Falls, Iowa 50617.



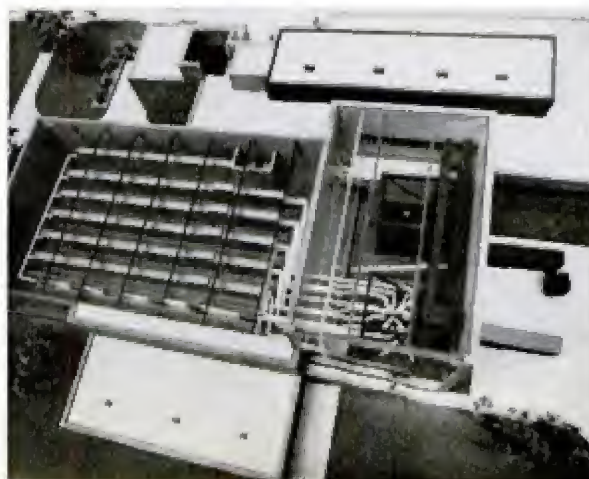
## Halo hoop for safe night biking

"Two halos on earth are better than one in heaven," says the inventor of a new reflectorized device for safe bicycling at night. Reflexite vinyl plastic ribbons mount on plastic tubes that weave through spokes in both wheels. Over 40,000 microprisms on each square inch of hoop enable drivers to see a bike from the rear, front or side at night. They're \$3 to \$5 depending on wheel size. Everybody's Bicycle Shop, 168 Main, Northborough, Mass. 01532.



## Waterless plug-in 'johnny'

Toilet that uses no water, chemicals or incinerating fuel makes it handy for summer cabins. "Ecolet" is odor-free and operates on house current to activate a thermostat-controlled coil to vaporize liquids, leaving dry residue. Fan vents odors through roof. Installs with a drill, keyhole saw, ruler. \$685. Ecolet, 9800 West Bluemound Rd., Milwaukee, Wis. 53226.



## Laser fusion lab has 24-beam zap

In a billionth of a second, 24 high-power laser beams at University of Rochester's Laser Energetics Laboratory will zap a pinpoint-size target of nuclear fuel simultaneously. Tool, due for full power in 1977, will heat target atoms to 90 million degrees with a jolt equal to the power output of all U.S. electric plants. Result, hopefully, will be fusion.



# AM radio bounces back

High fidelity? Stereo? AM is getting more and more like FM—with advantages of its own.

by Harry Maynard

Since its beginning, FM has been glamor radio—first for noise-free, high-fidelity sound that didn't fade when you took your car radio through an underpass, then for stereo, and now even for four-channel, quadraphonic broadcasting.

AM has been the workhorse, carrying longer distances than FM and receivable by almost any radio ever made, including those produced before FM was invented.

Until very lately, the workhorse has been losing ground to the thoroughbred. AM still gets three-quarters of the \$2 billion spent annually for radio advertising and 60 percent of radio's 210 million listeners per week. But AM had a long head start. Today, with virtually all radios receiving FM as well as AM broadcasts, plus the impact of stereo, AM's lead looks increasingly slim.

But now AM is rising to the challenge: improving its sound through better transmission and (if the FCC permits) through stereo or even quadraphonic broadcasting. AM's sound is already a lot better than most AM listeners give it credit for. The law permits AM stations to transmit a wide audio frequency range all the way to 15,000 Hz, and many stations do that well. (The ear hears from 60 to 20,000 Hz.)



Hi-fi components that don't stint on their AM sections include the Dynaco AF-6 (left), Heathkit Modulus (below) and Technics receiver (below, right).





But most of the inexpensive portable or table radios that people hear AM on can hardly pass the 100 to 2500-Hz audio range, are too insensitive to pick up any but the strongest signals clearly, are plagued by interference, and are limited by tiny speakers that produce only tinny sound. Even the AM sections of component high-fidelity tuners and receivers are frequently cheap, poorly designed circuits. ("We add a \$10 AM circuit and charge \$40 or \$50 more than for our FM-only model," a hi-fi engineer once told PM's electronics editor. "Nobody complains.") And the fewer listeners who can hear the difference at home between good and bad AM broadcasts, the less motivation AM stations have to clean up and improve their signals.

### Some good AM already here

Still, there are some stereo components with good AM performance now appearing (a sampling is pictured below) and one AM-only tuner (tested, next page) whose performance is superb.

Paradoxically, one thing that has contributed to revived interest in good AM has been the failure of many FM stations to maintain engineering standards high enough to exploit the full potential of their medium.

FM is theoretically a superior medium—but only if its listeners have high-quality receiving gear, live close enough to a station to get a strong, multipath-free signal—and if the station they live close to puts out a good enough signal to be worth their trouble.

FM is free of static, sounds the same both day and night (AM sound and range change after dark), and its "capture effect" automatically

excludes the weaker of two stations operating on the same frequency, so you don't get two signals at once. All these advantages are inherent in the FM medium.

In addition, the standards used in FM allow a full, high-fidelity frequency range of 30 to 15,000 Hz and the greater dimensionality and realism of stereo and four-channel capability.

But these same standards dictate

an FM disadvantage: range. FM is inherently capable of greater range than AM, but the VHF band allotted to FM broadcasting restricts its long-distance capabilities. (See page 74, Aug. '76, for a chart of the radio spectrum.)

### Stereo AM coming

AM's greater range leaves millions still depending almost exclusively on it for their radio fare. Where an FM station's maximum range is usually about 150 miles, a 50-kilowatt AM station can consistently reach out 300 to 400 miles by day and, helped by sky waves after sunset, 1000 miles or more by night.

In cities and hilly country, AM is far less prone than FM to multipath distortion, the same signal-reflection problems that produce "ghosts" in TV pictures.

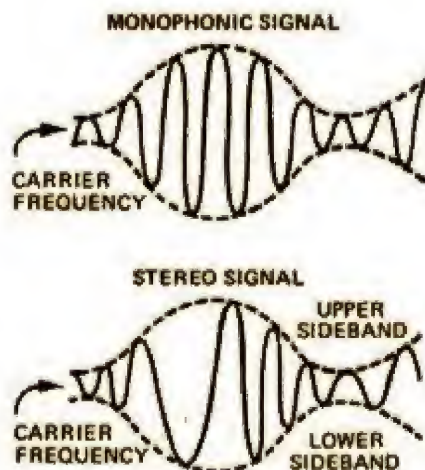
And in many suburbs or fringe areas, listeners are near enough to hear FM stations, but not close enough to pick them up in stereo (FM loses 60 percent of its range and much of its signal-to-noise ratio in stereo).

For those listeners, and any others who spend much time listening to AM, there's good news ahead: Stereo AM is coming.

The question, though, is: when? Three hundred AM stations, according to a recent survey, say they will convert to stereo just as soon as the FCC approves one of the several AM stereo systems currently being proposed and studied by the National AM Stereo Radio Committee (NASRC)—or, quite possibly, one that the committee isn't studying.

AM stereo is already old: In 1925 station WPAG, New Haven, broadcast AM stereo from two transmitters, one for the left channel and one for the right, on different frequen-

### How two AM stereo systems work



**Regular, monophonic AM** (top) has an unvarying carrier frequency whose changing amplitude, or height, carries signal information. Wave is symmetrical; upper and lower sidebands are alike. (In FM, the carrier's amplitude is fixed. Frequency variations carry signal information.)

In two simplest AM stereo systems, sidebands stay symmetrical while carrier frequency shifts just enough to carry channel-difference information (RCA), or carrier frequency stays fixed while different upper and lower sideband profiles carry right and left channel information (Kahn).





**A**n AM tuner for \$295? An AM antenna for \$175? Yes—and worth it if you want to hear AM that almost makes you think it's FM.

Even without its superantenna, the McKay Dymek AM-5 tuner rings around the highly praised AM section of my \$395 AM-FM tuner. The Dymek got more stations, more clearly.

It took the Dymek DA-5 antenna to bring my tuner's performance even close to the Dymek tuner's basic sensitivity, though not its noise rejection and frequency response.

Adding the Dymek antenna and tuner together was a revelation. I've heard worse from FM (though I have heard better, too)—and I could pick up AM stations hun-

dreds of miles farther off than FM would ever allow.

It takes two hands to tune the Dymek outfit: one hand on the antenna's tuning knob, the other on the tuner's. That keeps the antenna's sensitivity peaked at the frequency of the station you're tuning in. The tuner's signal-strength meter (the most useful I've seen on any tuner, then lets you adjust the antenna's tuning and its aim for the best possible reception.

The Dymek tuner's local/distant switch wasn't needed to prevent overload in any of my test locations, but it did help reduce interference pickup in strong signal areas. But the switch that selected wide or narrow-band response made more of a difference on the Dymek tuner than did the same switch on mine: The Dymek's narrow-band response was truer than my tuner's on its wide-band setting, and its wide-band response sounded almost like FM. Yet my tuner's narrow-band setting still let through more interference than the Dymek's wide-band setting!

The best AM yet takes McKay Dymek's AM-5 AM-only tuner (below) and DA-5 AM antenna (left). Antenna's head tilts and swivels for best signal pickup, interference rejection.



## HOW AM AND FM REALLY COMPARE

	AM regular receiving equipment	High-fidelity AM equipment	High-fidelity FM equipment
Fidelity	200 to 3000 Hz	30 to 10,000 Hz*	30 to 15,000 Hz
Distance, day	0 to 150 miles	To 400 miles	To 150 miles**
Distance, night	To 300 miles	To 1000 miles	To 150 miles**
Distortion	5 to 10%	Less than 2%	Less than 1%
Stereo	5 to 10%	Less than 2%	Less than 2%
Interference from TV	Bad	Very little	None
Interference from fluorescent lamps	Bad	Very little	None
Interference by stations on the same frequency	Bad	Very little, with adjustable antenna	None
Rejection of signals by mountains or buildings	None	None	Considerable
Programming	Different, but becoming less so		

\*30 to 15,000 Hz possible, with 100-Hz "whistle filter" notch at 10 kHz.

\*\*Mona only; stereo has shorter range.

cies. (The same technique was used in the early '50s, with one channel broadcast over a station's AM transmitter and the other on its FM frequency. "Binaural" AM-FM tuners were briefly on sale for these broadcasts.)

But two-transmitter stereo wastes valuable radio spectrum space; and those with just one radio hear just one channel of the stereo broadcast, not the full, balanced coverage they'd get from a monophonic broadcast. So as early as 1926, a patent was issued for stereo broadcasting on a single radio carrier.

## Different systems proposed

All the systems under study by the NASRC—two proposed by Sansui and one each from RCA, Motorola and Communications Associates—use a single radio carrier and give listeners without stereo equipment the full monophonic sound picture, just as stereo FM does.

But the one system NASRC isn't studying, that proposed by Kahn Research Laboratories, has the most interesting twist. The Kahn system is asymmetrical, putting one stereo channel on each edge or sideband, of the transmitted AM signal. Tune to the station's precise frequency, and you hear monophonic AM. But any two AM radios can pick up Kahn's broadcasts in stereo: Just tune one to the high side of the AM station's frequency and one to the low side. Space the radios a few feet apart.

There's an interesting twist to the Communications Associates system, too. The company claims that, besides bringing stereo to AM, their system would narrow station band width requirements enough to double the number of stations now on the AM dial.

With so many competing claims to sift through—and with much of their attention going to the current crisis in CB (see page 98)—the FCC will not be quick to approve one AM stereo system as a standard. And even once they do, some time will pass before you can get stereo AM broadcasts and equipment.

## What you'll need

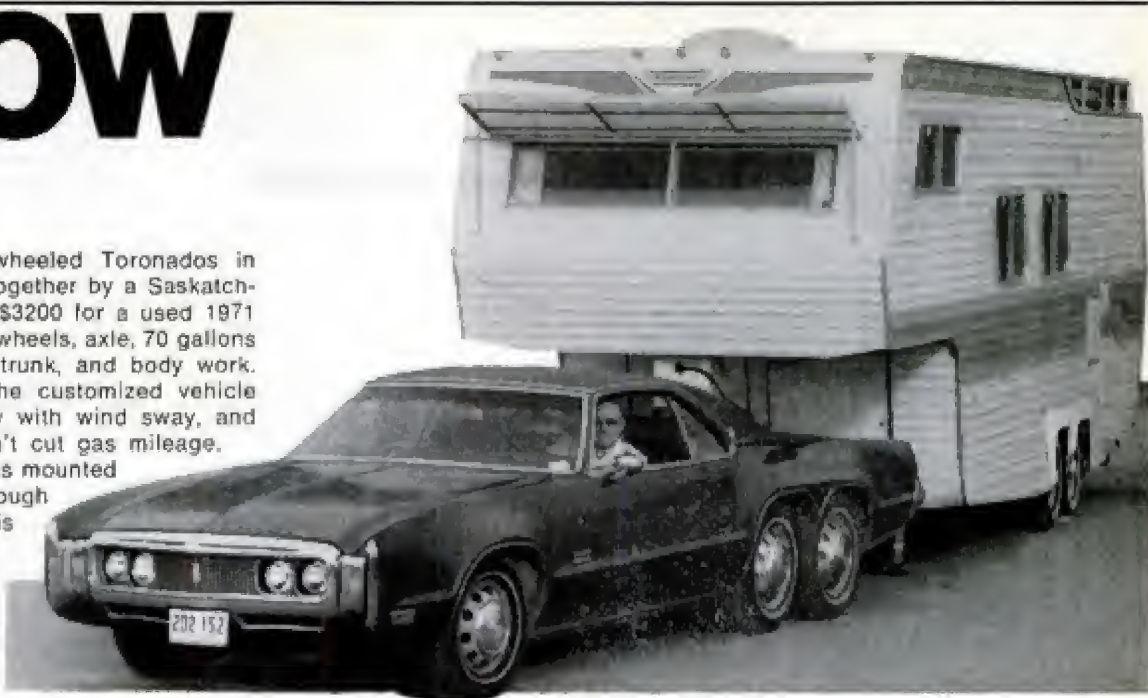
Will such equipment be expensive? It's hard to tell. You'll need to either replace your tuner with a new one or, if the tuner is built into a receiver or a compact stereo, supplement it with a new one for AM stereo. But if you're like most listeners, you've already made the big investment needed for a stereo conversion: two amplifiers and two speakers. As for AM stereo in your car, by the time it's ready, you'll be ready for your next new car. ★★



# IT'S NEW NOW

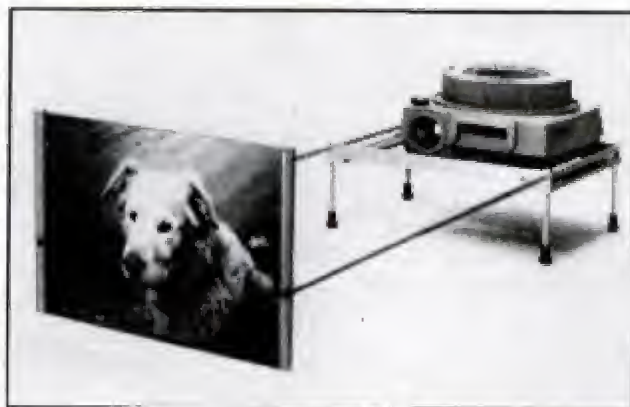
## Six-wheeled tow car

You won't see many six-wheeled Toronados in showrooms. This one, put together by a Saskatchewan trailer buff, cost him \$3200 for a used 1971 model, plus \$4600 for extra wheels, axle, 70 gallons worth of gas tanks in the trunk, and body work. According to the owner, the customized vehicle tracks perfectly, does away with wind sway, and the additional half-ton hasn't cut gas mileage. The fifth-wheel trailer hitch is mounted on a frame and extends through the trunk of the car. There is a problem, however. Passing drivers do a double-take, look at the conversion instead of watching the road and sometimes crowd the six-wheeler to the shoulder.



## Portable slide theater

With your own rotary-type projector, this screen and projector stand of aluminum can be set on a 12x18-inch desk corner or tabletop—with support rods sticking out—to show your slides. A 3M "Rigid Lens Screen" allows viewing in normal room light. Stowable in a briefcase, the portable unit sells for \$95.50 from Visual Horizons, 208 Westfall Rd., Rochester, N.Y. 14620.



## Quick-change camera clips

For photographers in the field, the ability to switch cameras or neck harness in a hurry is essential. Now a fast clip connector with a tough vinyl sleeve makes the quick switch easier. The unit attaches to any type of strap lug. It is available from Neck saver, Inc., Box 1712, Oakland, Calif. 94604.



## Solar mini-power

Silicon solar cells that power satellites have come down to earth in junior models. The "Solar Fan Cube" sports a grid of them above a tiny motor that turns a fan. In sunlight, the cells generate 1.2 volts—almost as much as a flashlight battery. \$20. Universal Specialties, 15 East 40th St., New York, N.Y. 10016.



## Seeing-eye phone monitor

A wristwatch-like device wired to an earphone and connected by optical fibers to a telephone transmits light pulses from the phone and converts them to tones a wearer hears. "Beeps" tell which lines are busy, ringing or on "hold." Called a "Bejed Probe," it's a new Bell unit for the blind.



## Digital thermometer-multimeter

Now there's a hand-held probe to give you a digital readout of surface or air temperature. It reads d.c. voltages to 750, resistance from 1 ohm to 19.99 megohms. Nickel-cadmium batteries make it portable and it tucks in a pocket, \$259 with case. Logical Technical Services, 71 West 23rd St., New York, N.Y. 10010.





# How to survive a blizzard in your car

by Robert Lund DETROIT AUTO EDITOR

**T**uesday, Nov. 10, 1940. A fine fall day in the Minneapolis-St. Paul area. Temperature 60°. Jacket and sweater weather, if you were going to be outside, but not cold by Minnesota standards. Most people stayed up beyond their normal bedtime. The following day was a holiday, Armistice Day (since changed to Veterans Day) and you could sleep late Wednesday morning.

Next day, Wednesday. The temperature dropped during the night and snow was falling by the time the late sleepers rolled out. But nothing unusual. The weather is always flip-flop in Minnesota in November.

But Armistice Day, 1940, was unlike any other Nov. 11 in the recorded history of Minnesota. Old-timers who survived the brutality nature visited on Minneapolis-St. Paul that day still recall the experience with a shiver 36 years later.

In a 24-hour period, the temperature plunged 60°. The light wind, light snow of the early part of the day built into a snarling, howling blizzard. The wind was so powerful a man could not stand against it. Snow piled up layer by layer—5 inches, 10 inches, 15 inches. The official measurement was 16 to 20 inches. Farm animals were frozen alive in open fields.

The human bodies were found later. Forty-nine people died in the storm, some from exposure, some from over-exertion—trying to shovel out—some in their cars.

Winter is something you learn to

cope with if you live in the northern states or Canada. While most storms are not as vicious and tragic as the blaster that ravaged Minnesota, every northerner old enough to have a driver's license has a story of a particularly savage winter.

Winter is especially tough on people who have to use their cars. By listening to weather forecasts, you can plan some nonessential driving for times when conditions are likely to be favorable. But this isn't much of a solution for drivers who have to drive five or six days a week, good weather or bad. Snowstorms in the top tier of states are difficult to predict. Freak storms can come on without warning—with no mention of the storm in the weather forecast.

Even a light snow of a few inches can immobilize automobile traffic if the snow is accompanied by strong winds. Wind causes drifting. If the wind is strong enough, a 2 or 3-inch snow can drift 2 to 3 feet high.

## Basic gear

I live about 10 miles from downtown Detroit. It's a built-up suburb, not a rural area. If Detroit has a 5 or 6-inch snowfall—we have at least one or two a winter—I can count on spending the better part of a day digging out my driveway because of the way the snow drifts in front of the garage door. If the wind is right, a flat 5-inch snow in Detroit piles up to 4 feet on my driveway.

You can take a lot of the risk and worry out of winter driving by equip-

ping your car with some basic gear and if you know what to do should you become snowbound to a point where you can't move your car.

## What to carry

There are two different lists of take-alongs to consider. One is a list of on-car or in-car items. The second is an emergency pack.

Most drivers living in snowbelt states already have the on-car/in-car items. These include snow tires, traction devices—chains, mats, sandbags—a good spare tire (be sure it's inflated), jack and lug wrench, jumper cables, a spray deicer for windows, a graphite spray for door locks, shovel, tow cable or chain, extra fuses and a junior toolkit—pliers, screwdriver and adjustable wrench. Spray-can chemicals are available for melting ice to give traction under the wheels. Or you can make your own. For a good "home brew," mix sand and salt or use granite poultry grit. These can be stored in milk cartons.

That's a fairly standard list of equipment for keeping a car moving under most nonemergency conditions. But what if you get caught in a blinding blizzard, snow as high as the headlights and no CB radio.

If you have a survival kit in your car, you don't do anything. You sit there until the storm stops and you can dig your way out. Or you wait for a rescue crew. If the idea of a survival kit reads like dramatic nonsense, check the newspapers this winter on the number of motorists



# bound

who wind up in the hospital—or worse—as a result of being stranded.

The survival kit should contain certain basics, but beyond that you can get as elaborate as you wish. Here is the basic list suggested by the Minnesota Para-Rescue Team and the Minnesota State Automobile Assn. (AAA).

Face mask, first-aid kit, matches and candles, a small knife, safety pins, aspirin, 40 to 60 cents in dimes, compass, flashlight with spare batteries, paper towel, facial tissue or toilet paper and a supply of food. The Para-Rescue Team recommends storing the supplies in a three-pound coffee can with a plastic lid.

## Take high-energy food

The food should include honey, semisweet chocolate, instant coffee or a mocha mix, raisins or other dried fruit in small packets, candy bars (heavy on the chocolate) and gum. Experts don't include it on their lists, but I recommend carrying a jar of peanut butter. It will keep for months without spoiling and is a rich source of protein. Another item I've found handy is an icepick or awl. Or substitute one of those old-fashioned can openers with a point at one end and a fold-in corkscrew in the center.

Thick mittens or work gloves should be tied to the coffee can with strips of cloth—bright red or orange. If you get in trouble, you can use the strips to signal or tie them to the antenna to attract attention. You should also have a half-dozen emergency flares for signaling at night and three or four reflectors.

Even though you are bundled up for winter driving, it's wise to pack extra clothing. Take along high boots or snowmobile boots, a stocking cap or winter hat with ear flaps and a padded jacket or heavy coat. The jacket or coat can be a castoff you happen to have around the house.

That's the basic list. If you want to go first class, add a thermal or

space blanket, sleeping bag, thermal underwear, a hand-heating gadget, transistor radio (so you don't drain the battery playing the car radio), snowshoes and all the fancy stuff sold for snowmobilers and skiers.

## First rule: don't panic

Now that you have all the gear, what do you do if you get zonked a hundred miles from nowhere?

The first rule, according to veterans of Minnesota winters, is don't panic. The storm will end eventually.

Stay in or near the car. You can leave it to find help if you know exactly where you are or you can see lights or human activity within walking distance. But if you don't know the territory, it's better to stay with the car. Even if you know where you are, don't try to walk for help until the storm lets up.

Don't attempt to push or shovel the car out of a heavy drift by yourself. You can try digging out if you have three or four people with you to share the shoveling.

If you shovel or exert yourself in any way that causes you to perspire, ventilate your clothes. Wet clothes lose insulation.

Keep front windows cracked an inch or so to let fresh air enter the car at all times. A freezing or wind-driven snow that drifts can seal a car so tight you can't get oxygen.

Don't sack out for any length of time. It's all right to doze, but it's important to exercise to keep warm. Move around in the car, climb from front seat to back, shake your arms and legs, clap your hands—anything to keep up your circulation. If there are more than one person in the car, take turns sleeping. Someone should be on watch to signal for help if a rescue crew shows up.

## Keep a light on

Turn on the dome light of the car at night and leave it on. Road crews and snowmobile rescue units can see a small light from a long distance. You can turn on the engine to run the heater and play the radio at times, providing you are certain no exhaust is seeping into the car.

How long will you have to wait to be rescued? That depends on the intensity of the storm, how long it lasts and how many other motorists are in the same fix. Rescue crews in the Midwest usually get to snow-bound cars on heavily traveled roads within 24 to 36 hours. If you are in the boondocks, you might have to wait three or four days.

If you do much long-distance driving during the winter, keep your gas tank full or nearly full. If you have to turn on the engine for a few minutes to get heat, it's reassuring to know you won't run out of gas. ★ ★ ★

## Useful items to be carried in the car at all times

First-aid kit, \$2.50—\$6  
Flares (set of three), \$1.75 set  
Tire inflator, \$1 each  
Flashlight (magnetic), \$2 each  
Tire pressure gauge, \$1.50—\$5  
Fire extinguisher (1 lb.), \$3.75 each  
Jumper cables, \$7.95 pair

Blanket, \$5—\$8  
Graphite aerosol spray, 75 cents each  
Wiping cloth, 50 cents each  
Chock blocks, \$2 pr.  
Warning triangle, \$7.49 each  
Pencil and notebook, 50 cents each  
\*AAA price or est. retail price

## Specific items to be carried in winter

Reinforced tire chains, \$20 set  
Traction mats, \$1.95 pr.

Small snow shovel, \$2.35 each  
Ice scraper—snow brush, \$1.50 each

\*Items available through American Automobile Assn. (AAA).



# Digital watches you build yourself

by David Sagarin

**B**uilding your own watch from a kit of tiny gears and springs would be a feat—but building an all-electronic watch or stopwatch is easy.

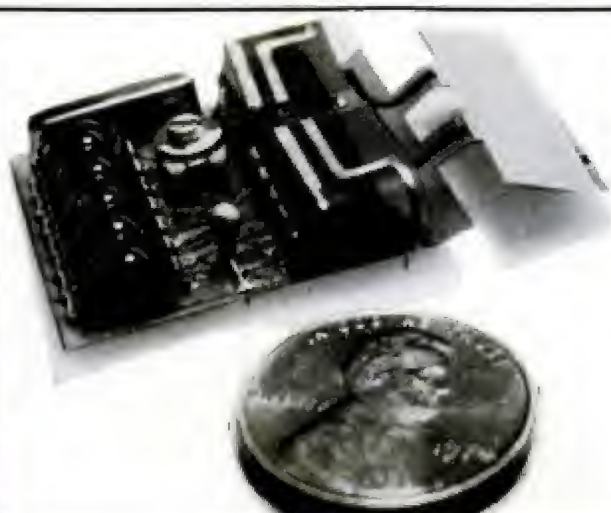
Sinclair's "Black Watch," at \$30 in kit form (\$50 assembled) is a large, fairly good-looking watch that stays black till you press it. Then it displays hours and minutes or minutes and seconds, depending on where you press. Resetting it is a pain in the neck, but it runs for six months or so on inexpensive batteries. And it takes less than two hours to build.

The stopwatch kits are naturally a bit larger and more expensive, and take longer to build—but they do more.

Intersil's Cronus 2K (\$70 in kit form, \$125 assembled) takes about two hours to build. Ours took longer, though, due to one missing part and

a minor error in the directions. The 2K times by hundredths of a second up to an hour, and its four function settings provide for lap, split, cumulative and time-out uses.

Heath's Deluxe Digital Stopwatch, Model GB-1201, took four hours to make and longer to check out. But it's a heck of a machine, with abilities you never thought you'd find at this price (\$85). It does everything the Cronus does, while simultaneously showing total elapsed time on a second display register, and can also count up to or down from a pre-programmed time and set off an external alarm. You can start or stop it by plugging in remote switches, electric eyes or other devices. The GB-1201 can time up to 100 hours by hundredths of a second or hundredths of a minute and works on rechargeable batteries or a.c. ★ ★ ★



**Sinclair** wristwatch kit has no visible controls: You just press the watch in one place (far left) to display the hour and minute, in another to display minutes and seconds. Pressing the right spot on the back of the watch will set the time. The watch's "works" (left) are simplicity itself to build, taking less than two hours; flap on the back is a printed-circuit battery contact. Works are shown about life-size here.

Stopwatch kits from Cronus (below) and Heathkit (right, with conventional stopwatch for comparison) have several functions (see text). Of the two, the Heathkit is the more expensive and takes longer to build, but it has more functions, two visible time registers, and connections for external switches.

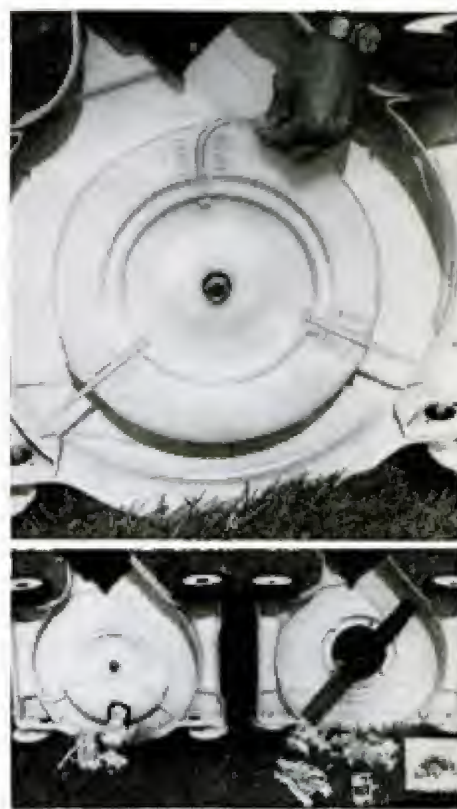






### Perch your camera or long lens on a bean bag

When you rest your camera on an "Omnipod" anything from the nearest stair rail to the branch of a tree becomes a "tripod." The handy camera rest needs only a place to plop it on to provide a stable perch. It comes in a zippered bag filled with tiny plastic beads. Some globe-trotting professionals leave the beads home, carry the lightweight case to their destination and fill it with rice, beans or similar local product for duty in the field. Three models include Amateur (3 x 7-inch, \$4.98); Professional (5 x 7-inch, \$6.98); Safari (6 x 8-inch, \$8.98). Add \$1 for shipping. Lederman, Inc., 630 South Clarence St., Los Angeles, Calif. 90023.



### Bladeless mower for safety

Three removable tapered plastic "whips" whirl at 18,000 feet per minute in a new rotary mower to slice the grass. But flexibility of the "Whip Stiks," demonstrated above, lets them bend when they hit objects. In tests (bottom) conventional rotary mangled objects put in its path. New "Blade-Less" model left them unharmed. The Roper Corp., 1905 West Court St., Kankakee, Ill. 60901.

### Sizzling, whizzing Wankel

Powered by a four-disc rotary engine developing 300 hp, a new high-speed boat is undergoing trials on Lake Constance in Germany. It is the latest brainchild of Felix Wankel, inventor of the unique engine bearing his name. Top speed of the craft has not been released, but the owner claims it will maintain a 60-mph cruising speed in all kinds of weather. Other innovations include a "dolphin-shaped" hull claimed to ignore heavy seas and an arrangement of flexible flippers designed to act as shock absorbers to dampen hammering at high speeds. The cockpit is enclosed and airconditioned. Craft is dubbed aqua-speedster "Zisch"—which, in English, can mean "whisper," "sizzling," "fizzling" or "whiz" depending on how it's said.



### Free-end hacksaw cuts you out of tight spots

This contoured handle accepts standard hacksaw blades, giving you a new kind of flexible hacksaw with a free end. Tool is designed to make curve, flush and tight-space cuts more easily. High-impact plastic holder allows blade-length adjustment from 2½ to 6 inches. At most hardware centers for about \$3. Its maker is the Nicholson Div. of Cooper Industries, Inc.



### Fire-alarm star for Christmas

Excess heat triggers a new Christmas-tree star ornament to sound off a built-in horn, alerting you that the tree is on fire. "Star-Alarm," hung high on the tree, is usable year after year. Its horn works on a regular flashlight battery. \$10 from Life-Alarm Corp., 2804 East 55th Pl., Indianapolis, Ind. 46220.



# New movie magic: The weird, wild world of special effects

The recently released movie *Futureworld* is typical of a new era in film-making in which electronic wizardry and computerized high jinks create mind-blowing visual tricks.

by Bill Shelton



**A** formation of shimmering, colorful triangles flies across the screen, gradually transforming themselves from geometric shapes into the human figures of three fierce-looking Samurai warriors. We see an actor's head, but not just from the outside—from the inside. A love scene is played in the abstract, with wildly gyrating patterns of light and color representing the explosive force of emotional reactions—all created by computer.

This is the kind of spectacular cinematic magic that fills the recently released science fiction movie *Futureworld*, a sort of super sequel to *Westworld*, itself a bag of technical tricks. The movie, produced by American International Pictures, may not win any awards for social comment or depth of characterization, but it is a special effects holiday, a visual blockbuster.

The film features a series of eye-popping surprises that special effects

director Brent Sellstrom likes to call "visual stings"—sudden, startling scenes that strike the senses as sharply as a bee sting. As evidence of just how far special-effects technology has come, many of the movie's mind-blowing visual blasts had to be created with the aid of million-dollar computers and video equipment in California and at NASA's elaborate Johnson Space Center in Houston.

The picture also represents one of the first major mergers between two long-warring factions in the enter-

**Weird, ghostlike effects** are achieved in the film by elaborate techniques involving computer graphics. At center above, actor Peter Fonda is first covered completely with white makeup, then photographed from all angles with grid of lines projected on his body. When grid information is fed into a computer and transferred onto film, his head appears to turn, shrink and fade away as in eerie sequence from movie at right.

At upper left, master special-effects creator John Whitney works at a computer.





Still photos:  
Dana R. Shelton

Movie scenes from  
Futureworld film,  
American International  
Pictures

Lifelike hand, fitted  
with electronic and  
mechanical innards,  
is used by film's  
"doctors" in the  
grisly business of  
putting together  
humanoid "people." Below are assorted  
feet and other body  
parts used in the  
process. The realistic  
pieces of human  
anatomy are actually  
plastic models  
made for study by  
medical students.



Faceless robot shown at right, without which  
no science fiction movie would be complete, is  
actually a live actor wearing helmet and face  
mask. Effect, nonetheless, is properly scary.

What seems to be a complex geometric pattern  
of triangles gradually changes into image of  
three Samurai warriors in sequence below—  
another of film's computerized visual tricks.



Actual Mission Control at NASA's  
Johnson Space Center in Houston  
(far right) was used as movie set  
to represent similar but fictitious  
control center in the picture.  
Photographing the room's many TV  
monitor screens proved to be a  
major problem because of annoying  
black "roll bars" produced by non-  
matching TV and movie frame rates.  
The bars were eventually eliminated.



tainment industry—the video men and the film men. Involved in the venture were almost as many video experts as film people, including some of the engineers who helped send the Apollo astronauts to the moon. Even *Futureworld* director Richard Hefron has done more work for TV than movie houses.

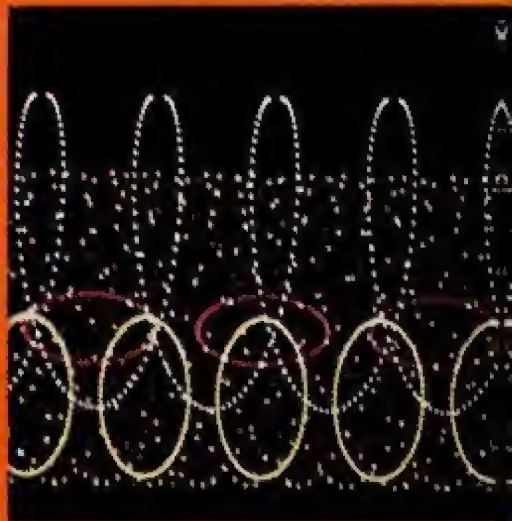
The principals in the picture are Peter Fonda and beautiful Blythe Danner. Fonda and Danner play rival reporters who go to Delos, the futuristic fantasyland straight out of *Westworld* where patrons can indulge their most extravagant desires—for a mere \$1200 a day, inflation affecting the price of tickets

as much in science fiction as in real life. Yul Brynner, in a cameo role, portrays a darkly garbed gunslinger, looking like he did in *Westworld*.

### Computerized romance

One "sting" that's bound to bring comments from movie viewers is a

*(Please turn to page 134)*



**Wild dream sequence**, in which beautiful Blythe Danner and gunslinger Yul Brynner play a tumultuous love scene, is one of movie's technical highlights. The scene is portrayed in three ways, with different techniques cleverly interwoven to produce a mounting emotional and dramatic impact. The performers, in an increasingly tempestuous courtship dance, are first shown as they would normally appear (sequence at left above). Then the figures slowly dissolve into smears (center sequence). The smears merge (bottom)—the embrace. At the same time, computer-generated "brain waves" flash on the screen representing Danner's rising sensations (sequence at right).



# World's fastest ocean racers

Called the roughest of sports, the wet and brutal game of offshore racing can break your bones and bankroll—but it produces better boats.

by Bill McKeown BOATING EDITOR

**T**he greatest powerboats before World War II were the rumrunners—those long lean aircraft-engined machines that could outrun the Coast Guard across open ocean with cases of bootleg liquor piled aboard.

But since then an even faster speed breed has developed. Approaching 100 mph, these new offshore racers outrun any military or civilian sea-going craft ever built before. Each year, marathon events of up to 500 miles take place along U.S. coasts in the Atlantic and Pacific, off the Bahamas and in Europe, and the winningest entries come from a North Miami Beach company called Cigarette Racing Team, created by offshore world champion Don Aronow.

The sport got started as a way of separating good boats from bad, and offshore contests have done more to improve pleasure craft than any other single influence. Sam Griffith, a Florida boat salesman, wanted to show that his sportfishing craft were strong enough to take on ocean waves. He drove them in races to Cuba during

pre-Castro days and later in the Miami-Nassau classic.

Hours of slamming into cresting Gulf Stream seas put hull, engine and crew to a brutal test, but Griffith was tough. A dirt-track racing driver before going to college, Sam was a pilot during WW II. Once, when his bomber caught fire and he had to bail out, his parachute failed to open, but he hit the only pond in that sector of North Africa. Eventually his bones grew back together. He was tough.

In order to slide over water rather than to push through it, speedboat hulls usually broadened back into a flat bottom aft, but in the 1950s naval architect Ray Hunt worked out a Veed

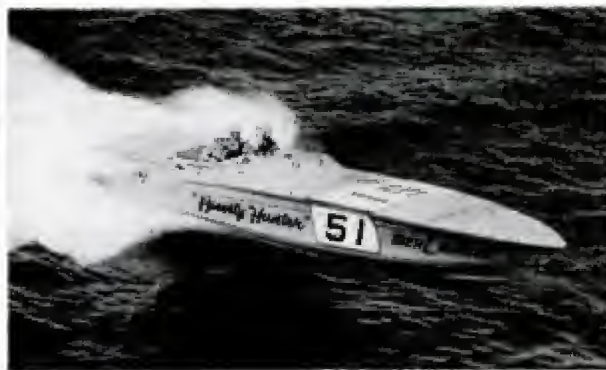
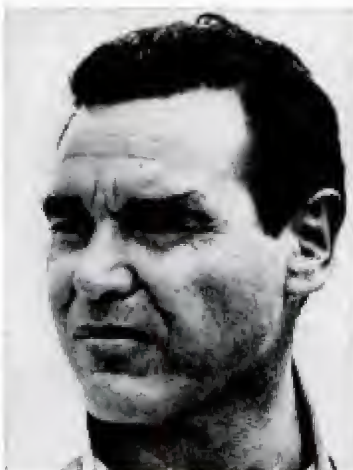
sea-kindly hull with only little flat ridges to get it up onto plane. He called it a deep-V design and in 1960 yachtsman Dick Bertram, with Griffith as co-driver, entered a custom-built deep-V 30-footer named *Moppie* in a 180-mile Miami-to-Nassau race that ran into small-craft-warning conditions.

## Rough race

A field of 27 boats started the race and *Moppie* won in a record-breaking eight hours. Nautical engineer Jim Wynne and I, in a smaller 25-foot deep-V, came in second two hours later, and the next finisher didn't arrive until the next morning. Fourteen craft broke up, blew up, turned back or sank along the way. The new deep-V had been proven as a true wave-tamer hull design.

Two years later sportsman Don Aronow entered a boat in the Nassau test, finished fourth and caught the fever. Back home in Miami he started a company to build boats to win the ultimate offshore tests, and since then has created companies called Formula, Donzi, Magnum, and now Cigarette. Other builders produce offshore machines, but Cigarettes have won every Miami-Nassau and all but one of the Bahamas 500-mile events since

**Tuning up** to try for the Miami to New York record (under 23 hours at 55 mph for the 1257-mile run), New Jersey's Billy Martin hopes for speeds of 70 to take the Chapman Trophy.



World champion driver turned designer-builder, Don Aronow leads the high-performance offshore field with his Cigarette Racing Team speedsters. Australian 40-foot Cigarette (below) won nine races in a row with this entry.





1969, plus numerous world championships and records. Recently Bob Nordskog, president of the American Power Boat Racing Assn., drove his own 35-foot Cigarette to an ocean speed record of 90.55 mph, and this year's brutal Cowes-Torquay test in the English Channel was won by the new British owner of the same Cigarette that Dr. Bob Magoon drove in 1974 to establish the ocean record of 23 hours from Miami to New York.

The hulls that can conquer big seas aren't made only for racing. For under \$14,000 you can buy a 20-foot run-about for the fun of driving a miniature performance boat, and models are also available in 24, 28, 35 and 36-

foot lengths. Latest is a 35-footer called the Mistress. With two 370-hp MerCruisers that deliver 64 mph, she costs \$44,990 and seats five. The first one was bought by Greek shipping magnate Niarchos as a tender for his yacht *Atlantis*, the world's largest.

But if you want to race, Aronow's 35-foot *Awesome Cigarette* mounts two 630-hp engines, costs \$85,000, and doesn't seat anyone. When you come off a wave crest at flying speed (Aronow once had a mid-air collision with a photo helicopter that was hovering too low), the reentry impact can be enough to crush the spine of any crew member sitting down. The driver, co-driver and navigator-mechanic, if

there is one, stand with knees flexed for as many pounding hours as the race goes on.

#### It takes teamwork

The cockpit is padded for two or three riders, and its placement is toward the stern where there is less violent pitching motion than up toward the bow. Some owners have standby systems installed so that if one hydraulic system or wiring harness is torn loose, another can be switched on. Some boats are rigged so that the driver only steers and navigates while the mechanic handles throttles, clutches, fuel switches and trim-tab adjustments.



**Maximum speed, horsepower, strength and performance in a minimum weight package.** the offshore racing machine tries to combine features that can handle the constantly changing conditions of an ocean course. Engines are staggered to lower them. Sterndrives prove faster than conventional V-drive inboards.

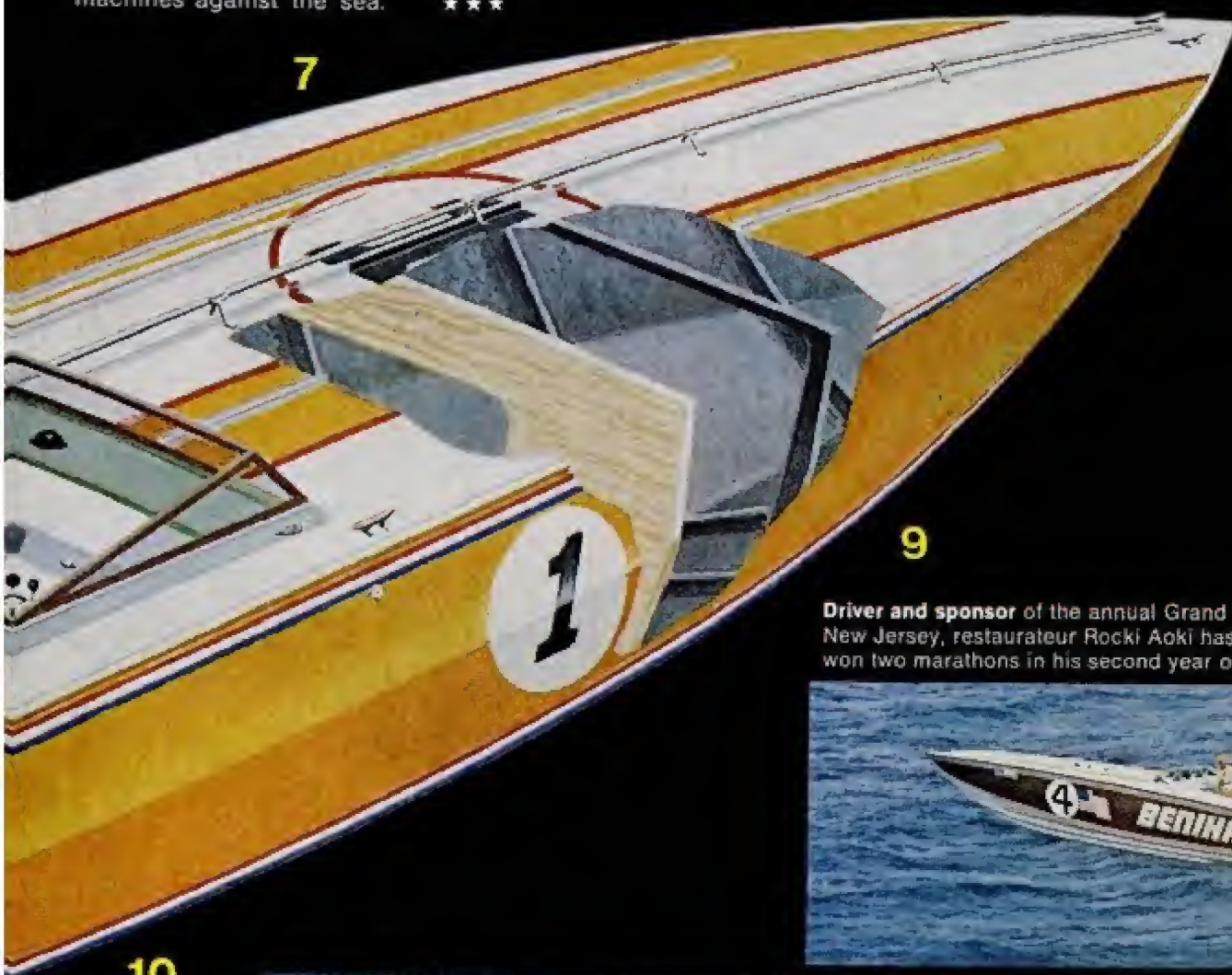


Prize money for a winner seldom covers the costs of shipping the boat coast to coast, airline tickets, motels, meals, mechanics and aviation fuel. Most racecourses are out of sight of land much of the time, with no spectators to applaud or appreciate the punishment of full-throttle driving. An owner out to try for the world championship will keep a duplicate boat and crew in Europe, and fly over and back 5 or 10 times during the year to compete in foreign races as well.

Yet new owners enter the sport every year and old drivers keep coming out of retirement. The reward still seems to be the challenge of men and machines against the sea. ★★

## 'Awesome' anatomy

- 1 Cleaver-blade props and tough but streamlined lower units add estimated extra 5 to 10 mph.
- 2 Special sterndrivers must take violent strains as hull jumps clear of water, revs surge and slow abruptly.
- 3 Adjustable trim tabs have replaced forward ballast tanks for matching planning angle to waves.
- 4 Ram carburetor intakes and tuned exhausts boost engine hp. Weight aft keeps bow up out of seas.
- 5 Driver's throttles are at right, clutches at left. Co-driver monitors fuel gauge switches, tab angles.
- 6 Low windscreen deflects some air blast and spray at speeds to 90, shields compasses and speedometer.
- 7 Arched deck mounts low life rail down centerline as required by some European safety rules.
- 8 Clean droop-snoot bow mounts only mooring cleats. Aft weight keeps bow from digging into waves.
- 9 Interior bow construction is light fiberglass skin over ribs, stringers to minimize bow weight.
- 10 Vee'd hull form prevents pounding, gives softer entry after craft goes airborne off waves.



Driver and sponsor of the annual Grand Prix off New Jersey, restaurateur Rocki Aoki has already won two marathons in his second year of driving.

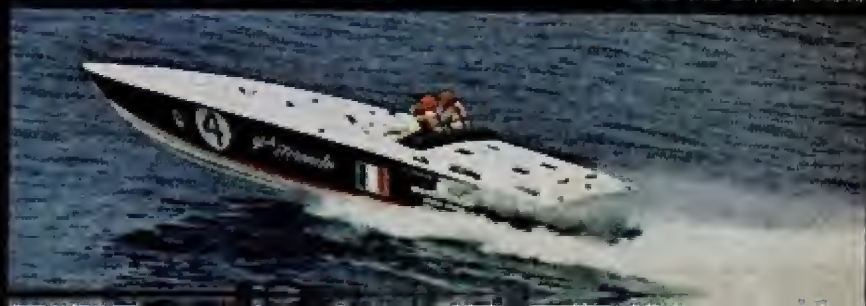


10



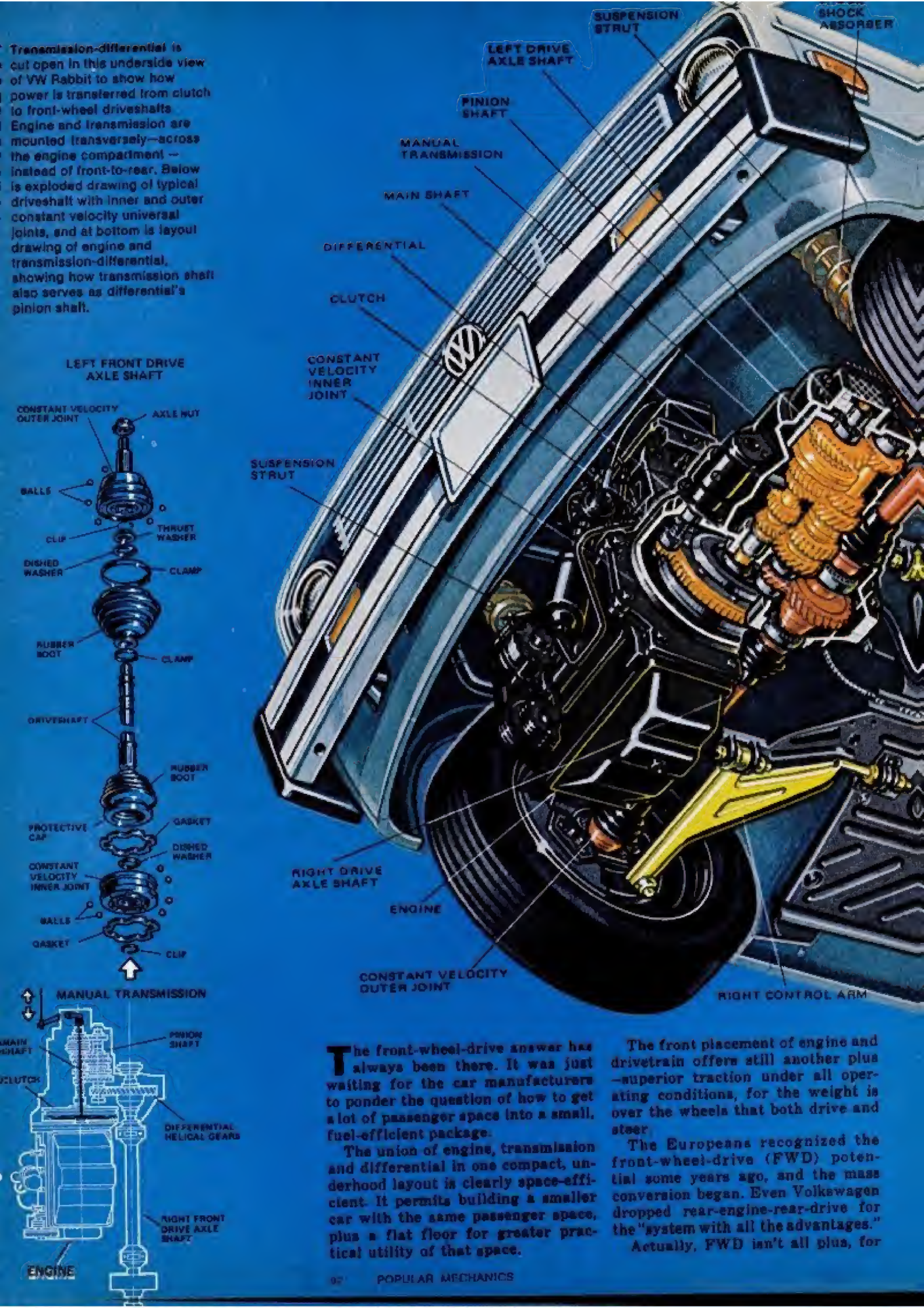
With No. 1 indicating national champion from previous year, driver Dr. Bob Magoon, Miami eye surgeon, went on to set a record 55-mph average for the 1257-mile run from Florida to New York.

**Black Tornado**, driven by Italian financier Vincenzo Balestrieri, helped him win two world's ocean championships while racing in Europe, South America and the United States.





Transmission-differential is cut open in this underside view of VW Rabbit to show how power is transferred from clutch to front-wheel driveshafts. Engine and transmission are mounted transversely—across the engine compartment—instead of front-to-rear. Below is exploded drawing of typical driveshaft with inner and outer constant velocity universal joints, and at bottom is layout drawing of engine and transmission-differential, showing how transmission shaft also serves as differential's pinion shaft.



**T**he front-wheel-drive answer has always been there. It was just waiting for the car manufacturers to ponder the question of how to get a lot of passenger space into a small, fuel-efficient package.

The union of engine, transmission and differential in one compact, underhood layout is clearly space-efficient. It permits building a smaller car with the same passenger space, plus a flat floor for greater practical utility of that space.

The front placement of engine and drivetrain offers still another plus—superior traction under all operating conditions, for the weight is over the wheels that both drive and steer.

The Europeans recognized the front-wheel-drive (FWD) potential some years ago, and the mass conversion began. Even Volkswagen dropped rear-engine-rear-drive for the "system with all the advantages."

Actually, FWD isn't all plus, for



# Front-wheel drive has arrived!

Even the Nova will have it soon, so shouldn't you know what it's all about?

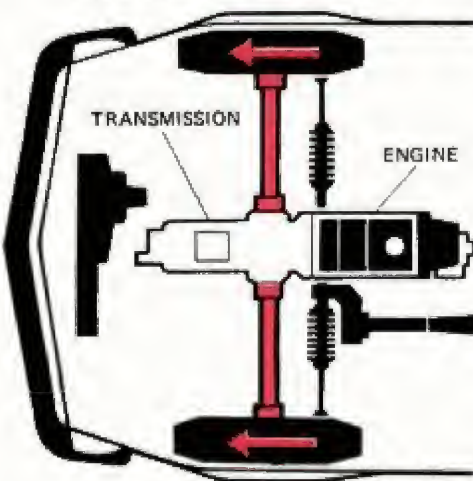
by Paul Weissler



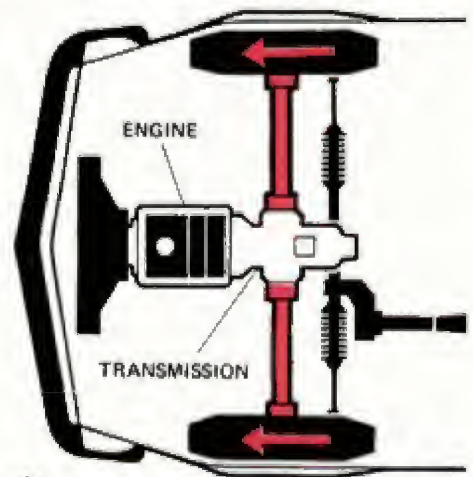
it costs more and is somewhat more complex than our familiar front-engine-rear-drive. However, Detroit is faced with government fuel economy edicts. It must build smaller cars and it wants them to be roomy. Result: Ford's Fiesta is FWD; ditto for Chrysler's upcoming subcompact. You know GM is familiar with FWD from the Olds Toronado and Cadillac Eldorado, and that experience is being used to prepare for a FWD Chevette and a whole line of FWD



## ENGINE AND TRANSMISSION IN LINE— TRANSMISSION IN FRONT



## ENGINE AND TRANSMISSION IN LINE— TRANSMISSION IN REAR



Front-wheel drive arrangements in use today are four: transverse-engine setup shown on previous pages, the two in-line setups shown above and the wrap-under arrangements shown below, right.

compact cars for production soon.

Unlike other drive-train layouts, there is no single standard FWD arrangement. At present there are four setups in popular use. Here is how they work, also what effects the FWD designs will have on some of the routine service a Saturday mechanic may do on his car.

### Transverse engine

The newest form of FWD, and perhaps the one with the brightest future, is the transverse engine and transaxle. It takes a somewhat short engine-transaxle combo to fit the components across the engine compartment, rather than front-to-rear, but it's being done, as shown on the previous pages on the VW Rabbit.

The Rabbit also has a novel clutch arrangement. The throwout bearing is at the rear of the transmission, and instead of pressing directly on

the hub of the clutch pressure plate, it pushes on a long rod that goes through a hollow transmission main shaft to the plate. The pressure plate is bolted to the crankshaft, rather than the flywheel.

The pressure plate and flywheel setup doesn't appear to have any particular advantage, but the location of the throwout bearing in the transmission means that it is lubricated with oil, and even if it should fail, removal of the transmission end cover (adjacent to the left front wheel) gives ready access to it. No need to drop the transmission as in most cars.

### Drive to the wheels

Instead of a conventional countershaft, the VW transmission has a pinion shaft that does the job, and also serves as a propeller shaft and pinion shaft. The pinion gear is on the front end of the pinion shaft to carry the power back toward the front of the transmission. Here, at the front side of the transmission, the pinion meshes with the differential ring gear, which delivers power to the drive axle shafts.

### Drive axle shafts

Unlike one-piece axle shafts used in conventional front-engine-rear-drive differentials, those in a FWD setup resemble the propeller shaft.

The VW setup is typical, with what is called a constant velocity (CV) universal joint near each end of what is actually a three-section shaft.

A short stub shaft is splined into the differential side gear at one end and the inner CV joint at the other; an intermediate shaft between inner and outer CV joints; and a final section with the brake caliper and wheel hub at one end, and the outer part of the other CV at the other end.

The CV joint does two things: It permits the axle shaft to assume rather extreme angles in any direc-

tion and at the same time transmit power to the front wheels without loss or change of speed. Clearly this is necessary if the front wheels and axle are to be able to respond to road irregularities and steer the car.

The CV joint on the Rabbit consists of two flanges, one that fits inside the other, on the sections of axle shaft. Each flange has six grooves inside for steel balls.

A cage with six holes (to hold the balls) fits into one flange and over the other. The balls protrude through both sides of the cage and fit into the grooves of each flange. Retaining rings hold everything together.

The cage is free to swivel at any angle, and power is transmitted through the balls, which can rotate in the grooves as necessary. Therefore, there is no angle at which the universal joint will bind, as in an ordinary U-joint, so the power is transmitted evenly, regardless of angle. To appreciate this, just try removing a bolt or sparkplug with a socket wrench that has an ordinary U-joint, extension and ratchet, holding the ratchet so as to produce various angles at the U-joint. You will find that there is some amount of binding at almost any angle, that the turning action of the U-joint is not as smooth as when the socket, U-joint and extension are kept perfectly straight.

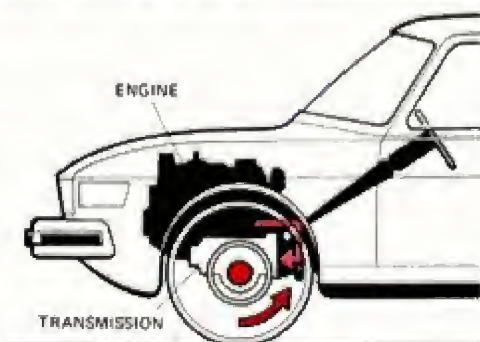
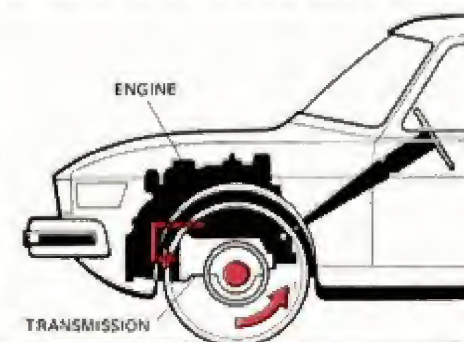
Although the VW constant velocity joint is a popular design, there are many others, such as the old Bendix-Weiss design, which had four balls in curved slots and a fifth in a center pivot. Another is the GM front-wheel-drive inner CV joint, which has a Y-shaped yoke and ball-type bearings filled with needle bearings on each stem of the yoke.

### Engine and transmission in line—transmission in front

In some cases, the engine in a FWD lends itself to placement in

(Please turn to page 124)

## ENGINE AND TRANSMISSION IN LINE WITH WRAP-UNDER TRANSMISSION



Wrap-under transmission arrangement may be designed for either front or rear power takeoff from the engine. The power-takeoff-at-front-setup (left) is used by Saab while the at-rear setup (right) is used by Olds Toronado and Cadillac Eldorado.





Saab 99, set up for international rally competition, smoothly tracks through a corner in the hands of former world-champion rally driver Erik Carlsson.



Correct front-tire pressure is important on cars with front-wheel drive.

## FWD: the lifesaver

**W**hite knuckles and frozen face muscles are guaranteed the first time you go crashing through the woods as a passenger with former world-champion rally driver Erik Carlsson (above). But you quickly realize, he's relaxed and in perfect control as he sets up the Saab for each turn and bend. Pretty soon you're enjoying the ride—as I did on a recent visit to Saab's Swedish headquarters.

### Lower center of gravity

Erik is a very up-front guy—if you'll pardon the pun—and he admits he could get around the rally course we were on just as fast in a rear-wheel-drive car, but his technique would be different. Lower cg is an advantage of FWD, however, since it reduces the risk of roll-over.

The real margin of safety of FWD is, not for the pro, but for the non-expert driver. As Erik puts it, "It can save your life without your even knowing it." He's referring to the understeering characteristic (or run-wide tendency)



Lars-Einer Nilsson

of FWD cars. That makes them safer for the driver inexperienced in high-speed cornering techniques. Go into a turn too fast with a FWD car and there's less chance you'll swap ends or spin. It's this behavior of FWD cars that Erik Carlsson considers a great safety bonus for nonracing drivers.

### The supermarket spin

All of us, at one time or another, on a drizzly day, have sat blipping the throttle waiting for that opening in traffic. When you get it, you step on the gas and . . . yup, the rear end of the car starts coming around. The driver not trained to cope with such a situation could wind up like a sitting duck, sideways with traffic coming from both directions. It's what Saab's chief safety engineer, Lars-Einer Nilsson, calls the supermarket spin. He emphasizes that wheel spin with a rear-wheel-drive car invariably results in the tail going sideways. Front-wheel-drive cars are stable in such situations.

Lars, as safety chief with Saab, is concerned with all aspects of automotive safety. For example, the Saab 99 has the ignition key position on the floor between the front bucket seats, locking the gearbox and not the steering wheel.

It's unconventional, but safer. And, as I found out riding with him, he insists on his rear-seat passengers wearing their seat belts: In a collision he doesn't want them becoming projectiles and injuring him!

### Steering-wheel tug

In most driving situations, most drivers can't tell whether the car they're driving has FWD or rear-wheel drive. A giveaway, however, is the steering-wheel tug you feel when accelerating quickly from a standstill. More pronounced on some FWD cars than others, it may take some getting used to if you've just switched to FWD after driving rear-drive cars all your life.

### Front-tire pressure

"What's the most important thing to do or take care of if you own a FWD car?" We asked Mike Murray, National Service Training Manager for Datsun at the introduction of the new F-10 FWD models. "Check front-tire pressure frequently," was his immediate reply. "Maintaining correct pressure is extremely important where the front wheels are doing the driving, steering and better part of the braking."

That's good advice for those who drive FWD cars now, and for many more who certainly will be by 1980 when almost all new small and medium-size cars will be front-wheel drive.—B.H.

### FRONT-WHEEL-DRIVE CARS

#### Those sold in the United States now:

Audi: Fox and 100LS	Renault: 5, 12, 15, 17
Cadillac: Eldorado	Saab: 99
Datsun: F-10	Subaru: Sedan, DL, GF
Fiat: 128	Volkswagen: Rabbit, Scirocco, Dasher
Honda: Civic and Accord	
Lancia: Beta	
Oldsmobile: Toronado	

#### Those soon to be available or in development:

Alfa Romeo: Alfesud Ti	Citroen: CX
AMC: FWD mini to replace Gremlin	Ford: Fiesta
Audi: New 100 (replacement for 100 LS)	GM: Chevette, Nova, Ventura, Omega
Chrysler: FWD compact (from Simca)	Skylark, Camaro, Firebird
	Renault: 30



# CB: New channels now...

## What the FCC's new rules mean

by Ivan Berger  
ELECTRONICS EDITOR

**I**t's official. Effective January 1, the 27-megahertz citizens band will expand from its present 23 channels to 40. CBers will welcome this, but not the 4000 or so businesses now using the new CB frequencies; they'll have to share them until 1979, then move to other channels.

Opening 17 new channels probably won't relieve the crowding on the present 23. Most owners of 23-channel sets will continue using them, rather than trade-in, and sets that operate on the new channels will still use the old ones. And in areas where CB traffic hasn't jammed the lower 23 yet, 23-channel sets will probably keep right on selling.

But widening the band will at least reduce the rate at which channels 1 to 23 become clogged with traffic. New-set buyers will probably opt for the new 40-channel models and prefer talking to each other on the new, less-crowded channels.

The trend to sets that synthesize the frequencies they need, instead of using one crystal per channel, will accelerate: A 40-channel synthesized tuning section should cost little more than a 23-channel one, while 17 more crystals and sockets would boost the cost.

You'll also see more digital read-



Calculator keyboards and digital readouts make even more sense—economically and for convenience—when you have 40 channels.

outs, both because they're easy to engineer for frequency-synthesizing sets and because their numbers—unlike those squeezed around a circular knob—needn't grow smaller as more channels squeeze in.

Calculator-type keyboards, like that on the SBE prototype shown here, should also grow more common as the cost of rotary channel switches, and the number of clicks you have to count when changing channels, both rise.

### Brand-new channels coming

But the FCC admits the new channels are just an interim step. More channels will be needed than can be added without problems at 27 MHz. And peaks in the sunspot cycle, due soon (see page 97) will

play havoc with 27-MHz. reception.

By that time, the FCC hopes to have alternate frequencies available, in a band less under the sun's influence. These new frequencies will almost certainly be high enough to eliminate interference with TV sets and from car ignition.

### What about your old set?

But the present 23 channels—and present 23-channel sets—will be useful for at least a year or two yet, or until sunspot problems get bad (and experts differ over just how bad they'll get). Forty-channel sets will be about \$20 to \$50 more than 23-channel models (much of that due to the FCC's new, tighter technical requirements, designed mainly to reduce interference with other





# different channels later

services). So 23-channel sets may still sell, just as inexpensive 6-channel models now do. And even if all sets sold from now on were 40-channel models, it would take years until they outnumbered the 23-channel sets now in use.

If you're planning to switch to a 40-channel set, check whether you can get a trade-in, or have your old set remanufactured (Hy-Gain and SBE have already announced remanufacture plans for some of their models, depending on when they were sold). But adapters to add onto old sets will be quite illegal.

## Other new rules

In addition to the rules designed to lessen interference, the FCC will now require an engraved or riveted-on serial number on all CB sets to stem the swelling theft rate.

And a copy of the FCC's citizens band regulations must now be packed with every set—no more long waits for them to come from Washington.

Channel 11 is no longer restricted for use in hailing other stations to arrange to converse on another channel. (Nobody ever used 11 for that, anyway.)

And the channel numbers are no longer official. FCC documents now identify channels by frequency alone. But the industry has standardized on the same, familiar numbers for the 23 original channels, and numbers 24 to 40 for the rest—even though the frequencies of the new channels 24 and 25 fall between those of the old channels 22 and 23. So the dial numbers run in order, but the frequencies don't.

## The sunspots'll getcha if you don't watch out!

by Anthony Curtis

**T**here are millions of 27-MHz CB sets out there. Now, are we going to have to throw them all away?

It's likely we'll have to *put* them all away, at least. Not because the FCC says so, but because the sun does.

Thanks to the sun, the next few years will be wonderful for the CBER who wants to listen in on CB chatter several states away. But for the guy who wants to talk to someone on the other side of town, they'll be impossible.

Shortwave signals, including 27-MHz CB, move two ways: short distances along the surface of the earth by "ground wave" and longer distances by "sky wave," traveling up to the ionosphere and bouncing back down again.

The ionosphere is a layer of ions surrounding the earth, about 80 to 1600 miles up, that reflects radio waves. This reflection makes long-distance, even around-the-world, radio communications possible.

But the ionosphere's reflectivity depends upon the sun, varying both with the time of day (that's why radio broadcasts carry further at night) and with the sun's 11-year sunspot cycle.

## Natural nuclear explosions

Sunspots are large, nuclear explosions on the sun's face which send out clouds of radiation that beef up the ionosphere. The more sunspots, the better it reflects. Enough sunspots, and the ionosphere

gets so reflective that sky-wave signals from a distance can come in stronger than groundwave signals from a mile or two away.

That's great for ham and short-wave operators trying to reach the other side of the world. But most CBERs want to talk with their wives while they drive home from work, get Smokey reports from truckers a mile or so up the highway, or be able to call local police for help when trouble starts. A Pennsylvania CBER with a breakdown doesn't need a wrecker from Alabama. He needs to reach the gas station around the next bend.

In recent years, CBERs haven't had much of this problem; sunspots have been at a low-point, and only local, ground-wave signals have been reaching our sets.

But now, the cycle is climbing again, and the skip is in. Signals are skipping across the country like flat stones across a pond. Sunspots, which last peaked about 1969, and which reached their 11-year low in 1975, are now back on the upswing. The next peak is due in 1980—but for two years on either side of that date, or from about 1978 to 1982, reliable local communications will drop to a range of less than a mile, swamped by sky-wave signals from hundreds of miles away. Even next year, some experts say, you may have trouble talking across town.

So you'll soon have to throw that old CB away—or put it away until 1982. After all, it's illegal to talk to stations more than 150 miles away on CB—and why call

**There's more space** in the UHF band than in all the lower bands together. A good spot for CB?

UHF BAND: 300-3000 MHz.



home when you can't raise it until you're in your driveway?

### Nowhere to go but up

There's a way out—with such added benefits as smaller sets, more channels and less interference: Move the citizens band up to a higher frequency, such as 900 MHz in the UHF spectrum.

Technology has only recently opened up this band for general-purpose, two-way mobile radio use. The FCC is only now assigning frequencies up there to other mobile services. The band is wide and because it's new, it's little used.

That gives us room for hundreds of CB channels, if we need them, and there'd be no skip interference, ever—UHF signals travel only line-of-sight.

A new band would mean new sets, and a chance for the FCC to tighten up still further on its previously lenient technical standards and enforcement. But even if standards weren't tightened, CB would improve: The new bands would be well above the frequencies of car ignition interference, more channels would mean fewer sets per channel to step on each other, and the new channels could be FM.

### The good and the bad

FM discriminates against the static that makes even the quietest CB channel crackle today. FM's "capture effect" means you'll hear only the strongest signal hitting your antenna on a given channel, not a jumble of overlapping ones, as you hear now.

But that could mean that the signal you're trying to hear would be blotted out by a stronger one on the same channel. So without enough channels to alleviate the crowding, FM wouldn't work.

Luckily, there's space for enough channels in the UHF. (But let's not get too many. No sense monitoring two dozen empty channels to find one with somebody to talk to.)

Another advantage of UHF is interference from CB on TV sets would also disappear. The problem now exists because the CB band is just below the VHF-TV channels; CB above TV would be no problem.

But what about those millions of 27-MHz CB sets now in use? You couldn't convert them to the new band, let alone to FM.

A switch to new frequencies would obviously have to allow for the old sets to be phased out over a period of time, such as five years. ★ ★ ★

# Tomorrow's CB: Will you

## I can hardly wait

**R**ed Rover reached down to his wristwatch and extended its antenna to its full 3-inch length. Instantly, the time on its liquid-crystal display winked into the letters "CB." Red Rover touched three buttons—2,1,3—and the display showed the channel number, as the radio came alive with the channel's sounds.

"Break two one three," he said into the tiny grille below the display. "Anybody copy Red Rover, KZZZ1240, here on two-one-three?"

"Sure, come on back," was the reply. "You've got the Gravel Gertie, KQLJ2198. How're ya doin'?"

Red Rover didn't need the handle to recognize the voice. It sounded

natural and clear through the high-fidelity FM transmission on the new UHF CB band at 900 MHz.

Rover and Gertie chatted as freely as two friends on a party line. No one interrupted them, anxious to use the channel—after all, there were 499 other channels left for them to choose from.

As a plane streaked noisily past him, Red Rover raised the volume with a rocker switch on one edge of his radio's wrist case, then rocked it back once the plane had gone. When he thought he heard a weaker signal trying to come in, he pressed another rocker to lower the squelch level; hearing nothing, he pressed its other end to bring the squelch back up to normal.

## A broiling controversy?

**T**he idea of instant communication on your wrist is most appealing. But is it practical?

Shrinking a radio and antenna down to wrist size involves raising its operating frequencies into the UHF range, and 900 MHz seems a reasonable place in that range for CB.

But 900 MHz is also in the frequency band now used for microwave ovens. And if 900 MHz can cook a steak in minutes, would it cook your wrist? Or your eyes, as you brought the set up to your face to talk into it?

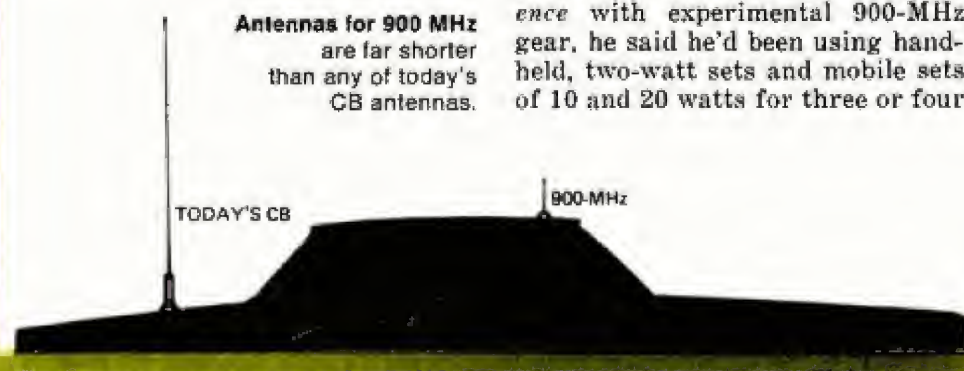
Probably—but not definitely—not. At the power available in a wrist radio, a fraction of a watt or so, and given the brief nature of most CB chat, it might take years of operation to turn you medium rare—if ever. (Microwave ovens use much more power and reflect most of it back toward the food

instead of radiating it away).

Speculation is rife: A spokesman from the American Radio Relay League considers that low-power 900-MHz transmission would be safe if you stayed at least a foot away from the antenna—easy enough in base or mobile sets, but not possible with a wrist radio. Sam Lewis, of Palomar Electronics, worries that a 900-MHz antenna on a car's trunk lid would be just about at eye level for the passengers inside, and a roof-mounted antenna would be at pedestrians' eye level; the eyes and testes are the portions of the body that suffer most from microwave heating.

Considering the prospect of a nation rendered blind or sterile by several million microwave transmitters, Bill Kanner, editor of *CB World*, says, "It would be a uniquely American way for civilization to come to an end."

But when I finally found someone, at Motorola, who'd had experience with experimental 900-MHz gear, he said he'd been using handheld, two-watt sets and mobile sets of 10 and 20 watts for three or four





# wear it on your wrist?

Wondering what time it was, Red Rover touched a button marked "T" and his radio displayed the time instead of the channel number. No need to bother Gertie with a "10-36" time request.

## Reality or dream?

Then, his conversation over, he coiled the stiff wire antenna back into his radio's case. As he did, the speaker went dead, and the display switched back to the time—until the next time Red Rover was ready to go on the air.

Farfetched? Well, yes and no.

It's all possible with today's technology: integrated-circuit chips, wristwatches with built-in calculators and keyboards, digital read-outs.

But putting CB on your wrist requires moving the band to much

higher frequencies. On the 900-MHz. band, for instance, a quarter-wave antenna can be a mere 3 inches long, while it would have to be 9 feet long for current 27-MHz CB frequencies. Even 2-foot, coil-loaded CB antennas would be hard to get up your sleeve, even without the bulging coil.

High frequencies mean smaller coils inside the radio, too—again, a help in making a radio small enough to fit your wrist.

CB on my wrist? With uncrowded channels and FM high fidelity? I can hardly wait.—Anthony Curtis

**CB Channel 476?** Could be—along with wrist-sized radios, 3-in. antennas and FM—if CB ever moves up into the high UHF frequencies. And it may have to.

years with no apparent harm.

So the band is *probably* safe. But a little research, before it is opened to CB, would do no harm.

## Even safe, still problems

This frequency region is no longer really at the leading edge of technology, but it's still some distance from mass-production status. That means 900-MHz equipment can be expected to be costly, certainly at first. With mass-production, and with increased use of integrated circuits and other cost-saving techniques, the price should come down. But how far? Perhaps it would come as low as today's 27-MHz gear, or lower—perhaps not.

Range is a problem, too: Microwaves travel only line-of-sight, though range is otherwise nearly unlimited. So a fraction of a watt of transmitter power might carry a 900-MHz signal hundreds of miles between mountaintops, but with a steel building or a small hill blocking the way, it might not carry to the next block.

The solution to that problem is technically simple: Add repeater stations. Automatic repeaters now pick up transmissions from ham radio operators on the 2-meter (144-148 MHz) band, and relay them to other operators (sometimes via other repeaters, sometimes directly), or relay messages to non-hams via telephone. A network of 900-MHz repeaters could do the

same for tomorrow's Cbers.

But who'll pay for it? Today's 2-meter repeaters are paid for by ham radio clubs, who maintain them primarily for their own members' use. CB repeaters could be paid for out of CB license fees.

Still, if the network included phone-patch facilities (which would be most desirable—it would give everyone with CB in their car a mobile phone) who'd pay the phone bills?

Another FCC proposal may hold the answer to this: ATIS, for Automatic Transmitter Identification Signal. Plagued by the problems of enforcing CB's current rules, the FCC has suggested that all sets to operate on any new band send out digitally encoded identification signals automatically at the beginning and end of each transmission. That way, the FCC could identify everyone making illegal transmissions.

But a repeater could also identify each user, and know where to send the phone bill for each month's

calls. ATIS would then make it possible for private enterprise to get into the repeater business, billing each user for his radio time as well as phone calls.

## No wrist radios ever?

If microwave wrist radios prove unsafe, what about the possibilities of wrist radios at other frequencies?

If 900 MHz turns out to be either unsafe or uneconomical, then the outlook will be even bleaker for still higher frequencies.

Below 900 MHz., making the radio system small enough presents some problems. Shrinking the radio part may be easier than it now looks, with the replacement of bulky coils with solid-state devices called "gyrators." But shrinking the antenna becomes harder and harder as the operating frequency gets lower.

By the time we actually get wrist radios—if ever—Dick Tracy may have long since retired from the force.—Ivan Berger





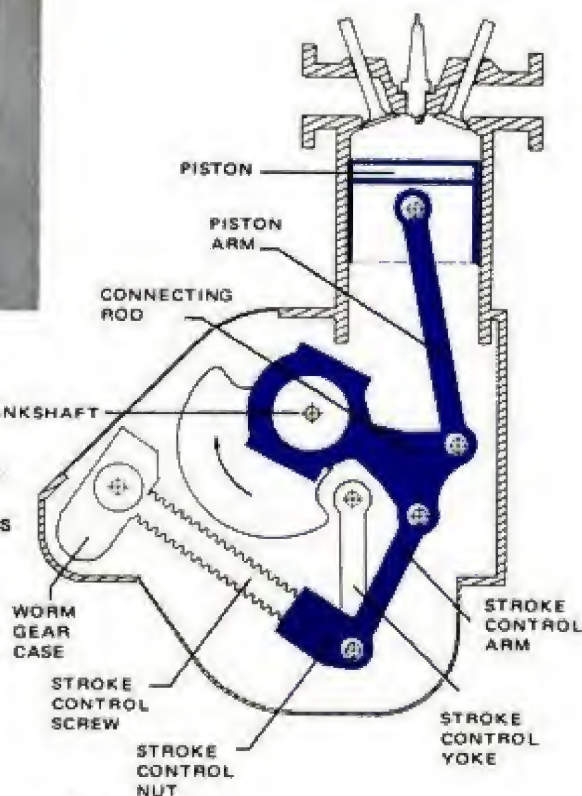
Ideally, every car should have two engines—one big and one small. The big engine would give power and acceleration. Then for cruising and top fuel economy, you'd switch to the little one.

While it's not practical to put two engines into every car, the next best thing might be an engine whose displacement shrinks and grows on command.

Such engines do exist. They've been around for years. So-called "variable-displacement" and "dual-displacement" engines become, in effect, big and small engines all in one. The displacement, or space inside the block that does the work, can be varied at will. If you need power to go up a hill, the variable-displacement engine's innards get bigger so it can do more work. But if you're merely cruising along on level ground, the displacement pinches down so you have just enough power to keep going, and yet you're not wasting a lot of fuel by supporting



**Working model** of linkage in cylinder of Sandia's variable-displacement engine is held by the inventor, Harvey N. Pouliot, above. Parts are called out at right. Gear-driven stroke control screws move lower ends of control arms, thus altering the arrangement of linkage between pistons and crankshaft and so controlling the distance pistons travel to turn the crank. Rigid stroke control yoke connects all control arms to assure equal, synchronous adjustment among cylinders. Here, displacement's at minimum. Drawings below show extremes of available adjustments.



# Engines that shrink and grow

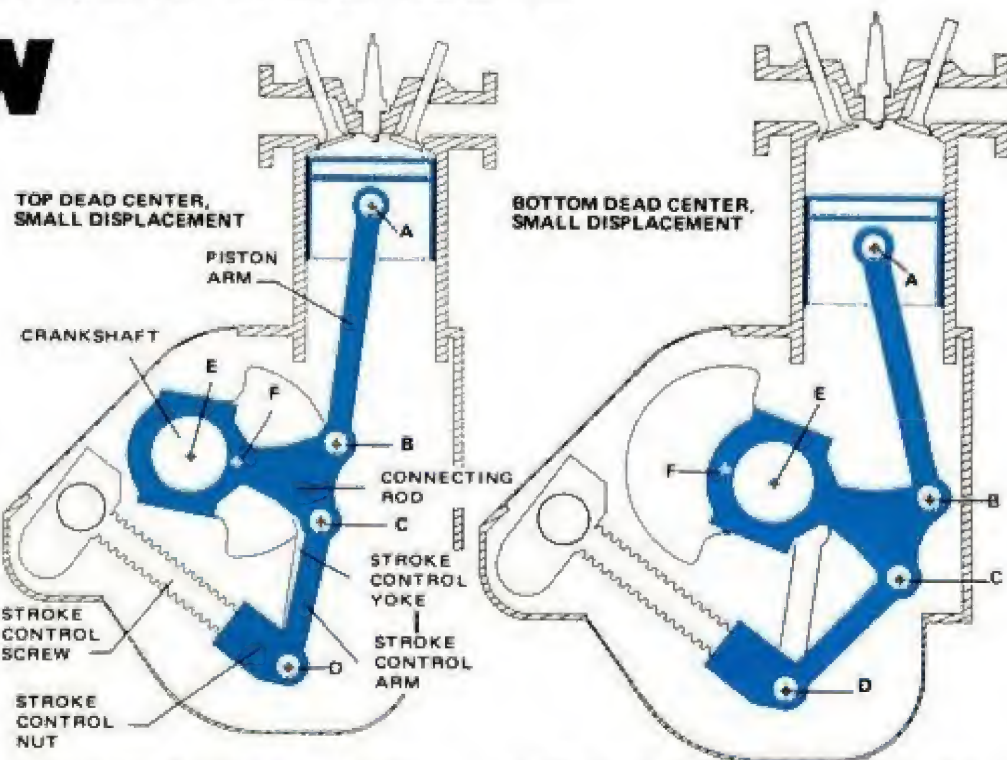
Variable-displacement engines have always made sense. Now they're coming.

by Michael Lamm  
WEST COAST EDITOR

a big powerplant and all its built-in pumping losses.

Variable-displacement engines aren't anything new, but two major companies are now working on them seriously in totally different ways. You've heard about Ford's six-cylinder engine that shuts down three cylinders at cruising speeds. That's one way—the simple way—to get variable displacement: Just shut off some of the working cylinders and run on the rest.

The other way to vary displacement is actually to change the stroke of an engine. That's what Sandia Laboratories in Livermore, Calif., is doing in an in-line, five-cylinder engine that's currently running under test. Sandia's engine is unlike Ford's, although both aim at the same results, notably better overall fuel economy. Ford claims a 10-percent improvement, and Sandia pegs



**Minimum displacement limit** is shown here with piston at top dead center. Lower end of the control arm D is nearly on line with piston axis and crank throw E is at its extreme left so pivot point C can move only to the right and a little downward as crank turns. This restriction limits point B to a similar degree and therefore limits vertical reciprocation of point A with the piston.

**Minimum displacement limit** is shown here with piston at bottom dead center. As point E rotates clockwise about crankshaft axis F and point C describes a simple and fairly horizontal arc sloping to the right about pivot point D, point B must also move down and to the right. Its pattern is the more complex, however, since it is influenced by the vertical reciprocation of A and the rotation of E.

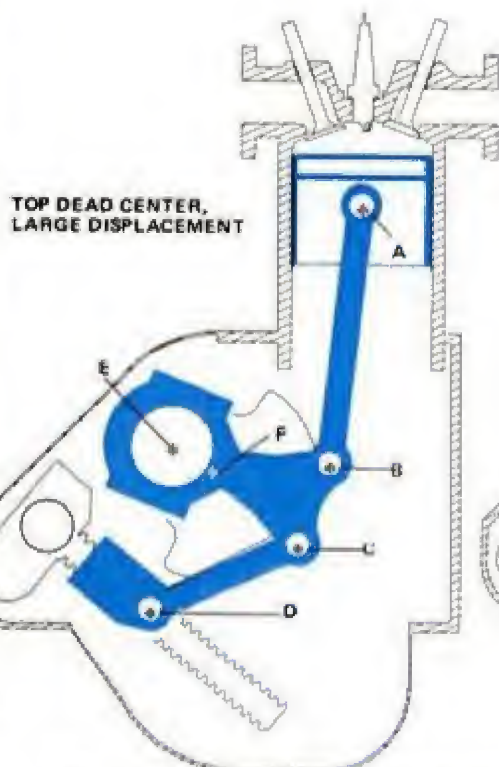
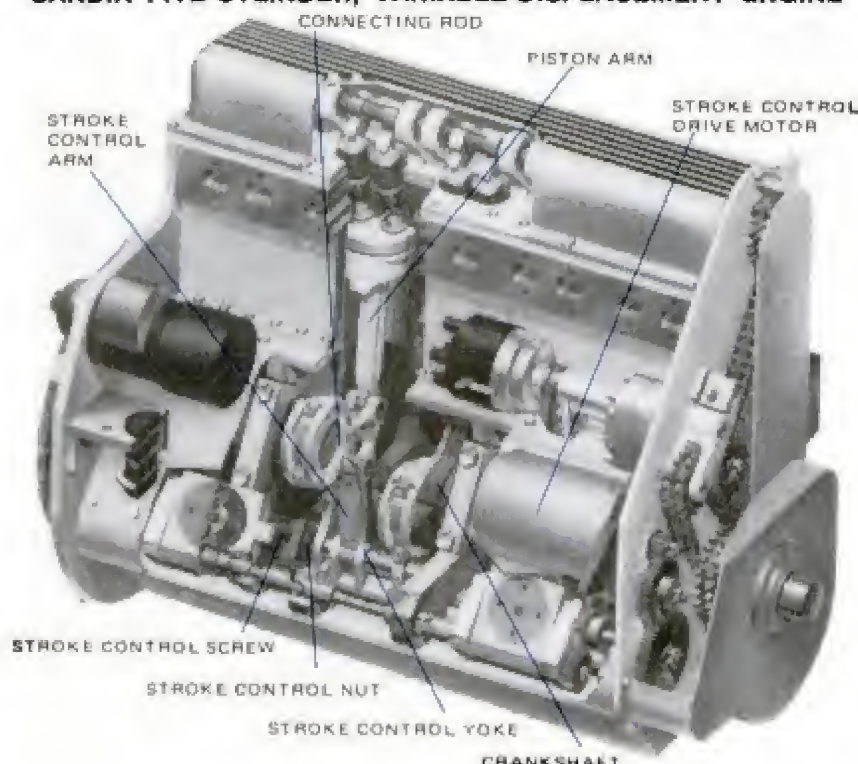


its improvement at 25 to 40 percent.

Developed by long-time Sandia engineer Harvey N. Pouliot (pronounced *Pooleott*), displacement of this five-cylinder, overhead-cam test

engine can go from 43 to 190 c.i.d. Stroke ranges from 1.25 to 4.25 inches. Stroke can be lengthened and shortened by a four-bar linkage controlled directly by accelerator-pedal

# SANDIA FIVE-CYLINDER, VARIABLE-DISPLACEMENT ENGINE



**Maximum displacement limit** is shown here with piston at top dead center. With D now offset as far as possible from the piston axis, the arc through which C travels becomes nearly vertical. And with D now closer to F as E rotates about F, the configuration requires a far more radical motion of C, driving the latter through a much wider arc. Since it must generally follow point C, point B, too, now travels farther and more vertically so there's a longer piston stroke.



**Maximum displacement limit** is shown here with piston at bottom dead center. With A, B, C and E all as far down and to the right as possible, the pattern of movement of the linkage has been fully traced and the full range of available displacements can be visualized. The geometry becomes easier to visualize if the possible movements at each pivot point are analyzed separately. All movements except those at B are simple circular or linear patterns.



**Dual displacement engine** from Ford, scheduled to go into light trucks in the near future, uses a computer-controlled solenoid to shut off intake and exhaust valves of three cylinders.

position and moved by an electric servo motor. One bar of the linkage drives the crankshaft, and the other three bars become the control mechanism for increasing and decreasing stroke.

Pouliot's idea is to run his engine at wide-open throttle at all times except when it's idling. Why always at full throttle? Because a conventional engine running at part throttle can't breathe efficiently. It's working against what engineers call "pumping losses." That means that the pistons are trying to pump a full volume of fuel/air mixture on each stroke, but they can't do that except at wide-open throttle. At cruising speeds, conventional engines burn up a lot of gasoline just to overcome inherent pumping losses. That's because at part throttle, each cylinder of a conventional engine is "gasping" or working against a partially shut carburetor.

In Pouliot's engine, the throttle stays wide open (except at idle), and what varies is displacement. At short stroke, power output is relatively low, and at long stroke it's high. But no matter what the stroke, there's only a slight pumping loss. That makes Pouliot's engine considerably more efficient than normal engines. And that's why computers tell us Pouliot should be able to get 25 to 40-percent more fuel mileage in the same car than with an equivalent normal auto engine.

## Why a Five?

Pouliot, who's a self-taught inventor/engineer/machinist, chose an in-line Five because computer calculations showed that Fours, Sixes, and Eights of this type vibrate much more when they're built as variable-displacement engines. A Five, for

*(Please turn to page 186)*



# How to adjust ignition timing

It'll still be quite a few years before breaker points go the way of the bulb horn.

by Mort Schultz

**D**well angle and ignition timing are the two most important adjustments made to breaker-type ignition systems. If you are a serious mechanic who wishes to advance beyond the change-your-own-oil stage, you must know how to adjust dwell and timing the *right* way.

Dwell (or cam) angle establishes how long distributor points stay closed between openings. Timing refers to the instant when spark occurs in a cylinder to start the fuel mixture burning.

Dwell angle and ignition timing are interdependent. Unless dwell angle is accurate, ignition timing won't be accurate.

The dwell angle adjustment is not made in electronic ignition systems that have no breaker points. There is no dwell if there are no points, but the timing adjustment is necessary whether your ignition has breaker points or not.

## Dwelling on dwell

The dwell period—when points are closed—is the time needed for the magnetic field to build up in the ignition coil so the coil attains full saturation. If this period isn't long enough, the spark won't attain full intensity.

Point gap (opening) and point dwell (closing) are adjusted the same way. The movable breaker point is moved closer to or farther away from the stationary breaker point. But when setting gap you use a feeler gauge, while to measure dwell you need a test instrument (dwell meter) costing \$15 or more.

Why can't gap alone be adjusted and let it go at that? Because the dwell angle measurement is far more exact. Points burn and pit, leaving uneven surfaces. A flat feeler gauge measures from high spots on the surfaces. It's not possible to get a

true gap reading, and this can affect the final ignition timing setting. A  $1^\circ$  variation in dwell leads to a  $1^\circ$  variation in ignition timing.

By using a dwell meter, you can adjust for exact opening and closing of points to permit split-second delivery of current.

Point dwell is set in degrees, because the distributor cam—the key component in setting dwell—makes a  $360^\circ$  circle. Dwell period depends on the number of cylinders, which in turn dictates the number of lobes (high spots) and flat surfaces the cam has.

## Counting cam lobes

The cam of the distributor in a four-cylinder engine has four lobes and four flat surfaces; that in a six-cylinder engine has six lobes and six flat surfaces; that in an eight-cylinder engine has eight each.

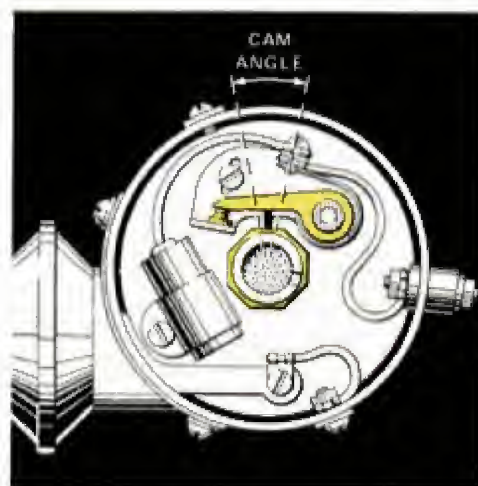
Each cylinder has the benefit of an equal part of the cam; that is, the dwell (when points are closed) and gap (the time points are open) for each cylinder equals that of all other cylinders.

Thus, in an eight-cylinder engine, the total period of time that each cylinder is influenced by point dwell and gap during one revolution adds up to  $45^\circ$  ( $360^\circ$  rotation of the distributor cam divided by eight). The coil's magnetic field must build up and collapse within this  $45^\circ$  period to get full spark to the cylinder.

In a four-cylinder engine, dwell and gap total  $90^\circ$  ( $360^\circ$  divided by four). In a six-cylinder engine, dwell and gap total  $60^\circ$ .

Remember, these figures represent the *combined* period in which dwell and gap occur. Dwell by itself represents only a part of the total.

The ideal dwell angle for each engine has been developed by the manufacturer, a  $30^\circ$  dwell angle setting



**1** Cam or dwell angle (see arrow above) indicates the period that ignition points are fully closed.

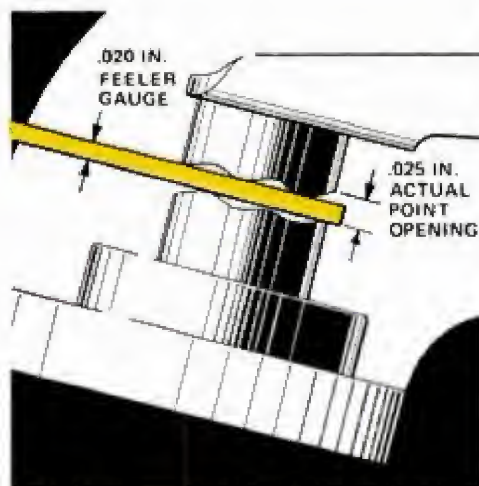


**5** Remote starter switch makes it possible to crank the engine while working under the hood.

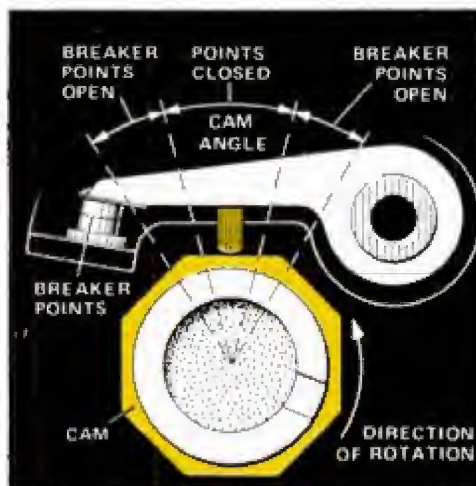


**7** Hoses to vacuum advance must be plugged (you can use pencil) before setting ignition timing.

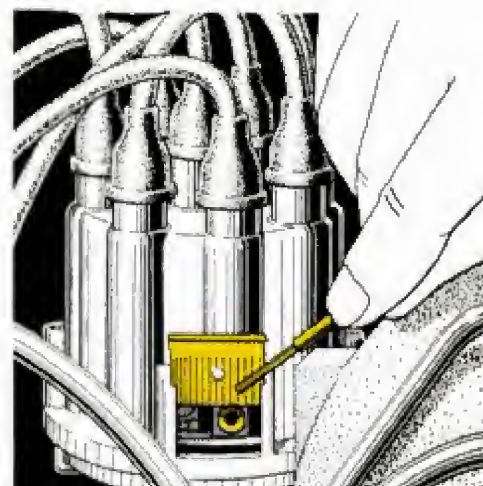




**2** A feeler gauge can't give you an accurate gap reading if the points are pitted; you must measure dwell.

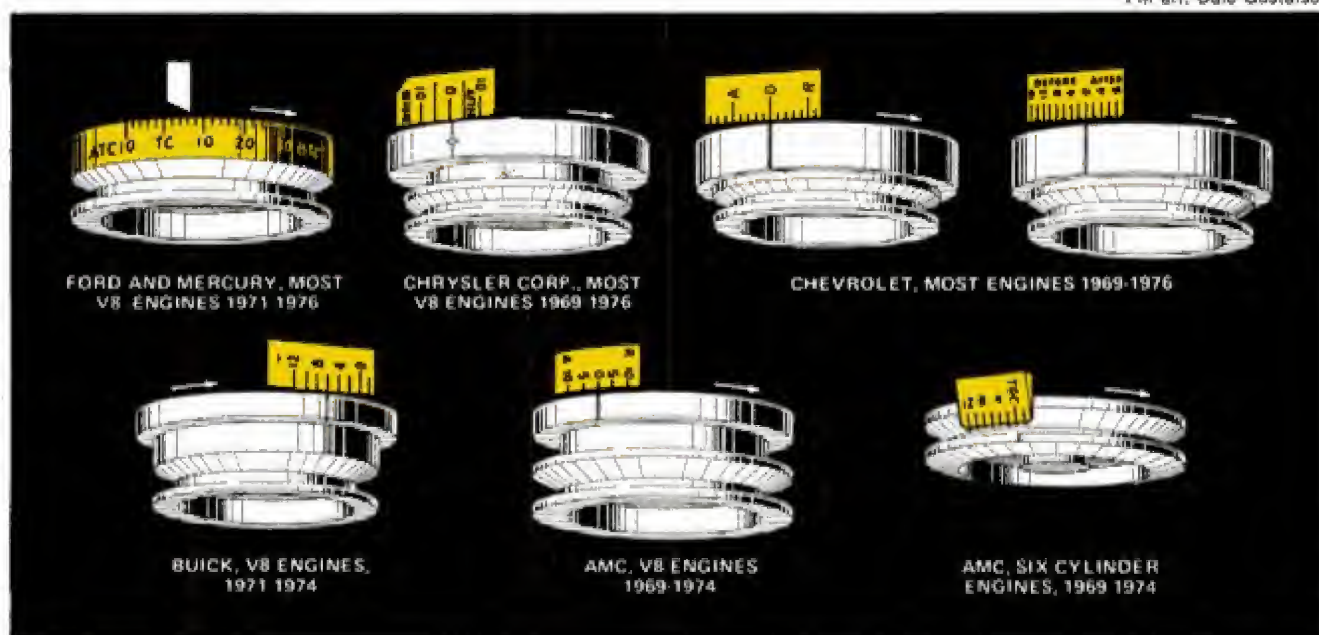


**3** Duration of dwell (points closed) and gap (points open) is the same for each cylinder of the engine.



**4** Adjusting points with this arrangement is easy: You don't have to remove the cap; just open "window."

PM art: Dale Gustafson



**6** Typical timing marks are shown above. Top row, left to right: Ford and Mercury, most V8s 1971-1976; Chrysler, most V8s 1969-1976; Chevy, most engines 1969-1976 use one of the two types of marks shown. Bottom row, left to right: Buick V8s, 1971-1974; AMC V8s, 1969-1976 and AMC Sixes, 1969-1974.



**8** Inductive pickup on some timing lights makes connection to the number one sparkplug a snap, literally.

is recommended. Thus, for one segment of the eight-sided cam, points are closed 30° of the 45° period.

To begin adjusting point dwell angle, you must first determine the recommended dwell-angle setting. If your car is a 1968 or newer model, this specification should be noted on a tune-up decal glued somewhere in the engine compartment.

### Determining specifications

If no decal is found, you can look for this spec in a service manual for your car, in a general automotive reference book at your library or, perhaps, in your owners manual.

Also available is *Motor Handbook*, a handy guide providing complete specifications for domestic and imported cars, trucks, farm tractors

and even outboard motors. Covering a five-year period to the present, it sells for \$2 and may be ordered from Motor Books, Box 2316, New York, N.Y. 10022.

The dwell-angle spec may be given as a range—for example, 29-31. If it is, adjust dwell for the lowest setting with the engine idling. The upper limit is used in a dwell varia-test, discussed later.

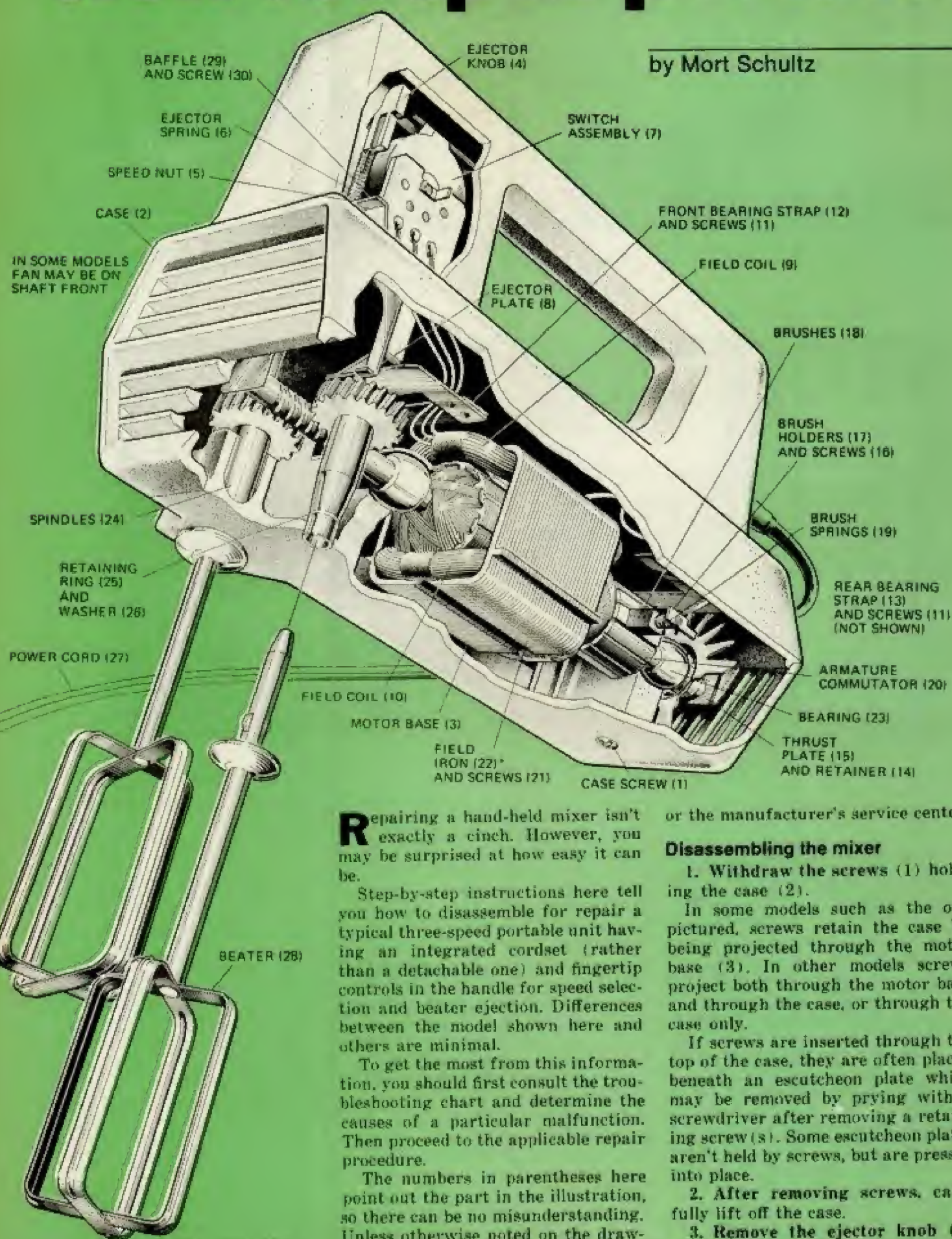
All dwell meters work the same, whether relatively inexpensive handheld models or part of a big console. There are two connections. One, usually colored red, is hooked to the terminal on the distributor (primary) side of the coil. The other, which is usually colored black, is grounded to the engine block or to

(Please turn to page 152)



# How to repair portable

by Mort Schultz



**R**eplacing a hand-held mixer isn't exactly a cinch. However, you may be surprised at how easy it can be.

Step-by-step instructions here tell you how to disassemble for repair a typical three-speed portable unit having an integrated cordset (rather than a detachable one) and fingertip controls in the handle for speed selection and beater ejection. Differences between the model shown here and others are minimal.

To get the most from this information, you should first consult the troubleshooting chart and determine the causes of a particular malfunction. Then proceed to the applicable repair procedure.

The numbers in parentheses here point out the part in the illustration, so there can be no misunderstanding. Unless otherwise noted on the drawing, parts are usually replaceable, being stocked by an appliance dealer

or the manufacturer's service center.

## Disassembling the mixer

1. Withdraw the screws (1) holding the case (2).

In some models such as the one pictured, screws retain the case by being projected through the motor base (3). In other models screws project both through the motor base and through the case, or through the case only.

If screws are inserted through the top of the case, they are often placed beneath an escutcheon plate which may be removed by prying with a screwdriver after removing a retaining screw(s). Some escutcheon plates aren't held by screws, but are pressed into place.

2. After removing screws, carefully lift off the case.

3. Remove the ejector knob (4) and switch assembly (7), held by a speed nut (5).

\* NOT NORMALLY A SUPPLY PART



# food mixers

## Motor won't run

POSSIBLE CAUSES	WHAT TO TRY
1. No voltage at the receptacle.	Check with a table lamp.
2. Damaged or defective power cord.	Inspect and/or test for continuity.
3. Bad switch.	Replace.
4. Other electrical breakdowns.	Check the circuit for continuity. If no open condition shows up, conduct checks outlined for a motor which has insufficient speed or power.

## Motor has insufficient speed or power

POSSIBLE CAUSES	WHAT TO TRY
1. Bearing or spindle is binding.	Tap appliance in the vicinity of the front and rear bearing straps and field iron with a small hammer or the handle of a screwdriver as the motor is running. An increase in speed indicates a binding condition.
2. Brushes are worn.	Inspect.
3. Shorted armature.	Check armature resistance from segment to segment on the commutator. Field resistance is about 5 ohms and commutator resistance, bar to bar, should be about 3 ohms. If resistance is noticeably lower or higher, replace the armature.

## Motor speed cannot be adjusted

POSSIBLE CAUSES	WHAT TO TRY
1. Bad switch.	Replace.
2. Shorted capacitor.	In those units that use a capacitor, replace.

## Motor is noisy

POSSIBLE CAUSES	WHAT TO TRY
1. Dry spindles	Lubricate.
2. Worn spindles	Replace.
3. Worn bearing	Replace.
4. Bent fan	Replace fan, if possible—replace armature if fan is an integral part.
5. Defective armature	Replace.

In some units the ejector knob, ejector and case are an integrated assembly. Replacing one requires that you replace all.

4. Unhook the ejector spring (6) and ejector plate (8).

5. Lift the ejector plate to disconnect it from the switch assembly. You may have to manipulate the switch so the ejector plate slips up past the switch knob. You may also have to force the ejector plate against the field coils (9 and 10) to slip the

plate from its slot in the switch bracket.

**Important:** As you perform this step, carefully notice the way it's done. Reassembly is performed in reverse order. If necessary, make written notes and a sketch.

6. Withdraw the screws (11)—in this model there are four—holding front and rear bearing straps (12 and 13), switch assembly, thrust-plate retainer (14) and thrust plate (15). Remove these parts.

## Removing the brushes

7. Withdraw the screws (16)—in this model there are two—holding the brush holders (17). This releases the brushes (18), brush springs (19) and brush holders. There are two brush holders, two brushes and two brush springs. One assembly is positioned on each side of the armature commutator assembly (20).

**Note:** You can replace brushes without doing step 3 and in many cases without doing steps 4, 5 and/or 6. Examine the brush holders to determine if this is possible when troubleshooting tests reveal that new brushes are needed. Once brushes have been removed, it is a good idea to replace them with new ones. *Replace both sets.*

8. Withdraw the screws (21) securing the field iron (22) to the case. Here there are three screws.

9. You can now remove the armature and replace the bearing (23) on the commutator end if necessary.

10. Remove spindles (24) by spreading the retaining rings (25). Slide the rings and washers (26) off spindle shafts, and lift spindles out of the top of the motor base.

11. If the power cord (27) has to be replaced, melt soldered joints. In all cases of electrical repair, make sure solder joints are made properly. Use the wiring schematic here as a guide in making electrical repairs, such as replacing the switch, field coils or power cord.

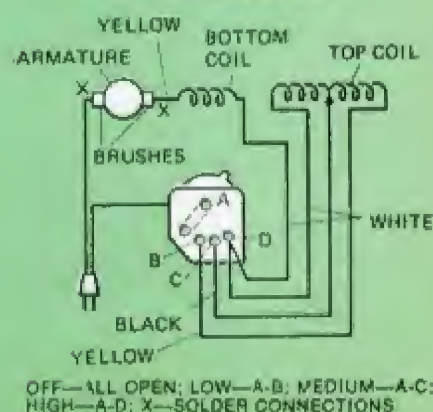
## Replacing beaters

12. Beaters (28) should be examined if the appliance runs but beaters don't revolve, spin sluggishly or whip. Look for bent rods and wear on beater tips. Replace them in pairs.

13. The baffle (29) may be replaced, if damaged, by removing the baffle screw (30).

Reassembling a portable food mixer is done the reverse of disassembly. Spindle shafts should be lubricated with appliance gear grease before they are put back in the motor base. ★ ★ ★

## WIRING DIAGRAM







# Lay a floor that'll outlast your house

PM's step-by-step guide for  
a professional tile job.

by Mike McClintock  
HOME AND SHOP EDITOR  
PM photo: George Ancona



**1. Prepare concrete slab:** Clean floor completely, then brush on a creamy-textured mixture of pure Portland cement. This bonds new "mud" to the old concrete floor.



PHOTOS BY THE AUTHOR



**2. Set up the mud:** The 1 to 2-in.-thick mixture (40 shovels sand to one bag Portland) can be smoothed and leveled with a straight board.



**3. Smoothing technique:** First tamp the edge of the board firmly across the surface. Then change to gentle, elongated figure-eight patterns.



**5. Touching up:** A long board may leave small voids in the concrete. After filling, use circular strokes with a trowel or short 2x4 for smoothing.

**H**ere come the wet boots and mittens, dripping snow shovels and occasional stray snowballs. When you lay a sturdy tile floor that water can't damage, you can forget about the drips and spills.

Mud-set tile is the Cadillac of floor installations. It will work over any concrete slab whether it's a basement, garage entryway, or utility room floor—even one that's old, cracked and out of level. It also makes a great fireplace hearth.

"Mud" is a mixture of sand and Portland cement. The ratio is 40 shovels of sand to one bag of Portland, mixed with water to a thick but workable texture. When it hardens, the tile is supported firmly and uniformly.

#### Overcoming the obstacles

A mud set, usually between  $\frac{3}{4}$  and 2-in. thick, will overcome all the shortcomings of a concrete slab.

Low spots take a little more mud,



**6. Laying tile:** Work on a small area (2x6 ft.) at a time. Start full tiles along the wall edge to minimize cutting. You can use the board for a straightedge, but space tiles ( $\frac{3}{8}$ -in. joints) by eye.

**4. Leveling the concrete:** Check for level across the top of your board. Use a hand trowel to shift the mud until the smoothed surface is level.

high spots a little less, but the surface comes out level. Check your floor with a flat 2x4 (long enough to span most of the room) and a level. By moving the 2x4 to different locations, you can determine the highest spot. If your floor has major cracks and substantial level changes (like two or three inches from one side to another) you should lay reinforcing wire under the new mud to strengthen it.

#### Setting up the job

Good preparation will make the job go smoother and faster. Here's a checklist for starting up your tile job:

- Have all your materials on hand.
- Clean the floor completely.
- Make your mud mixture with 40 shovels of concrete sand to one bag of Portland cement.
- Make a "dry" mix by adding  $3\frac{1}{2}$  gallons of water for each bag of cement. Pros never rely on a strict





**7. Using full tiles:** The more tile you lay, the easier it will be to judge the spacing and alignment. Save edge-cutting for later.

**8. Alignment:** Pros use 8-ft. magnesium rules. You get same results with a straight 1x4 pine board. Tiles will move easily.

**9. Seat tiles:** 2-ft. 2x4 block is laid across several tile joints and tapped firmly with a hammer to seat the group uniformly.



formula. If the concrete sand (some aggregate comes mixed in for strength) is very moist, they might add less water. If it's very dry, up to 4 gallons maximum. The test is to take a handful of the mix and squeeze it. When you open your hand, the mix should keep the shape of your fist. You'll need about one shovel of mix for each square foot of space.

#### One step at a time

To assure a good bond between the old concrete floor and the new mud mixture, brush on a thin layer of



pure Portland mixed with water. Then start troweling out enough mud to cover about a 2x6-ft. area. Use a straight length of 1x4 to level and smooth out the mix.

It's good policy to start laying out full tiles from the most visible corner of the room. You can use a short block (about 3/8-in. wide) to standardize the spacing between tiles or judge the spacing by eye. After you've completed a few sections, use a straight board to line up the joints.

To make sure that the tiles stay flat and level, lay a 2x4 block across

the joints, tapping it firmly with a hammer.

#### Edging and grouting

Crystalline-finished tiles can be cut with a scorer which weakens the surface so that the tile can be snapped cleanly along the scored line. Cutting quarry tile is another matter. The best option is to use a water saw. This machine cuts the tile with a water-lubricated friction blade. There are more ways to cut your edge pieces: If you mark the tiles, many suppliers will make the cuts for you at their shop. If you can't rent a water saw, a slate cutter is a good second choice. Although it's harder, you can cut the tile with a masonry nipper.

For quarry tile, make your grout mixture from equal parts of cement and masonry sand (a finer grade than concrete sand) and force it into the joints with a trowel or squeegee. Rub away the grout residue with heavy burlap rags.

After one week, the final mortar residue can be removed with a 20-percent solution of muriatic acid. A final sealer of lemon oil can be mopped on one day after the acid cleaning to bring your floor to a lustrous, water-repellent finish. ★ ★ ★



**10. Edging:** At top, full tiles are setting up. A water saw (rent from tile suppliers) easily cuts edging pieces with a water-lubricated friction blade.



**F**eaturing a lift-off tray with cleat feet, this handsome 20-bottle wine rack makes serving extra convenient. The rack shown was made of cherry and finished with two coats of clear satin finish slightly colored with a tablespoonful of walnut oil stain per  $\frac{1}{2}$  pt. of finish to give the wood an amber tone.

A fly cutter in a drill press makes quick work of cutting the 40 half-round bottle notches. Break the hole edges with a corner-rounding router bit, sand the edges smooth with a 3-in. sanding drum and rip the boards down the center with a combination blade.

The rails are attached to the posts in rabbets. First, preassemble two rail units (upper and lower), using glue and finishing nails to form two rectangles. Then, attach them to the front posts with glue and one diagonally driven screw as shown. Next, drill screw pilot holes through the backs of the three front bottle rails and glue and screw them in place. Finally, glue on the two rear posts and attach the bottle rails to the legs with screws driven from the backs.

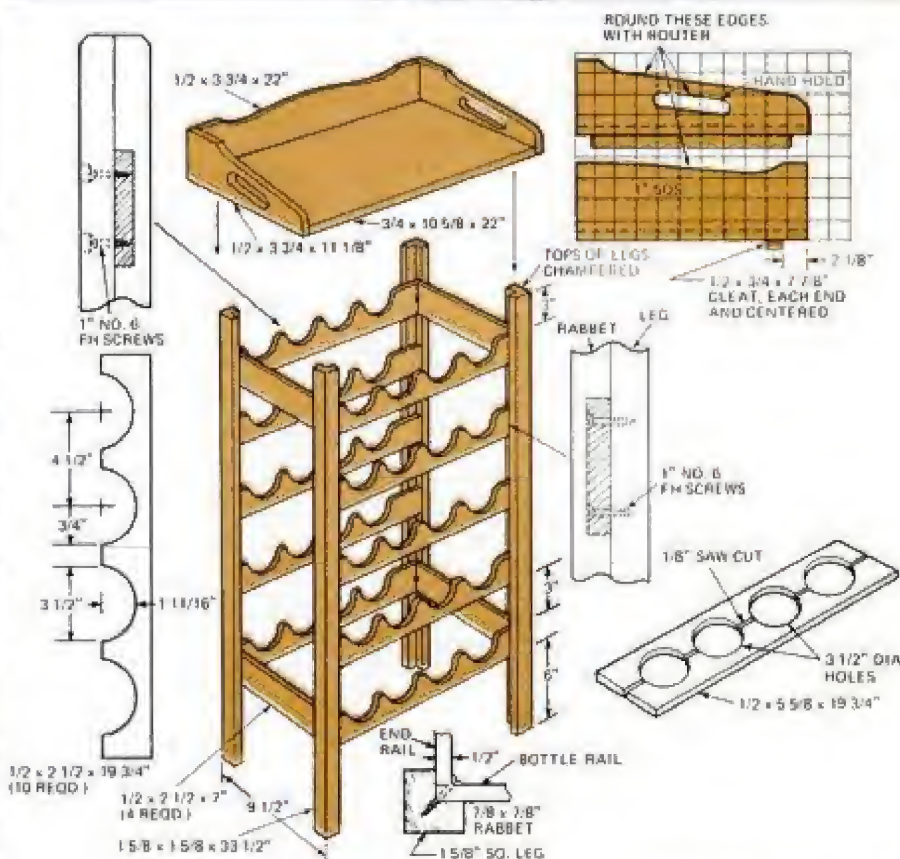
—Rosario Capotosto



**Set fly cutter** for  $3\frac{1}{2}$ -in. hole. Clamp work to a scrap board and drill-press table (above). After cutting holes, rip boards down the center to produce half-round notches (below). Holes can be cut with a sabre saw.



## Wine rack with tray





# PM's butcher block designs

**Y**ou can bring butcher block out of the kitchen and show off its beautiful wood grain in your living room with PM's plans for a sofa, chair and coffee table. They're designed for rapid construction, rugged use and contemporary style.

The same methods are used to build the chair and sofa shown in the photo. We'll detail the chair, and if you make the sofa, just substitute the dimensions on the exploded drawing and include the additional back and base supports.

## Maple sides and fascias

Cut a 2-in. thick, 30 x 72-in. butcher block slab into two  $35\frac{7}{8}$  x  $29\frac{7}{8}$ -in. pieces. Orient the sides to

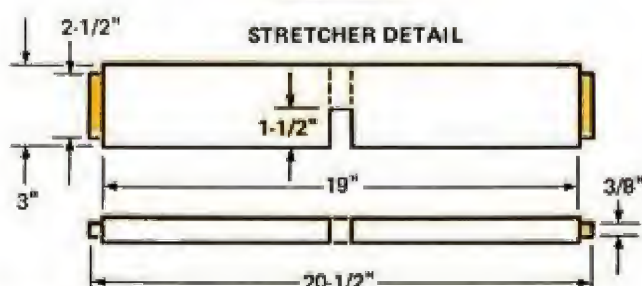
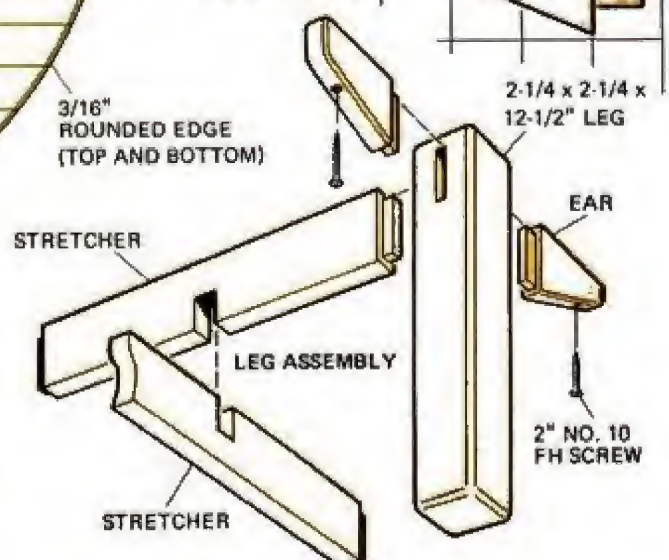
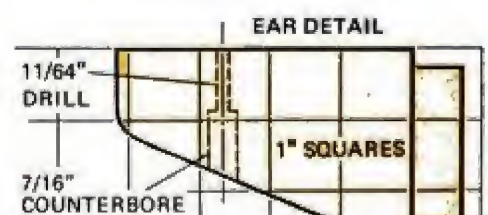
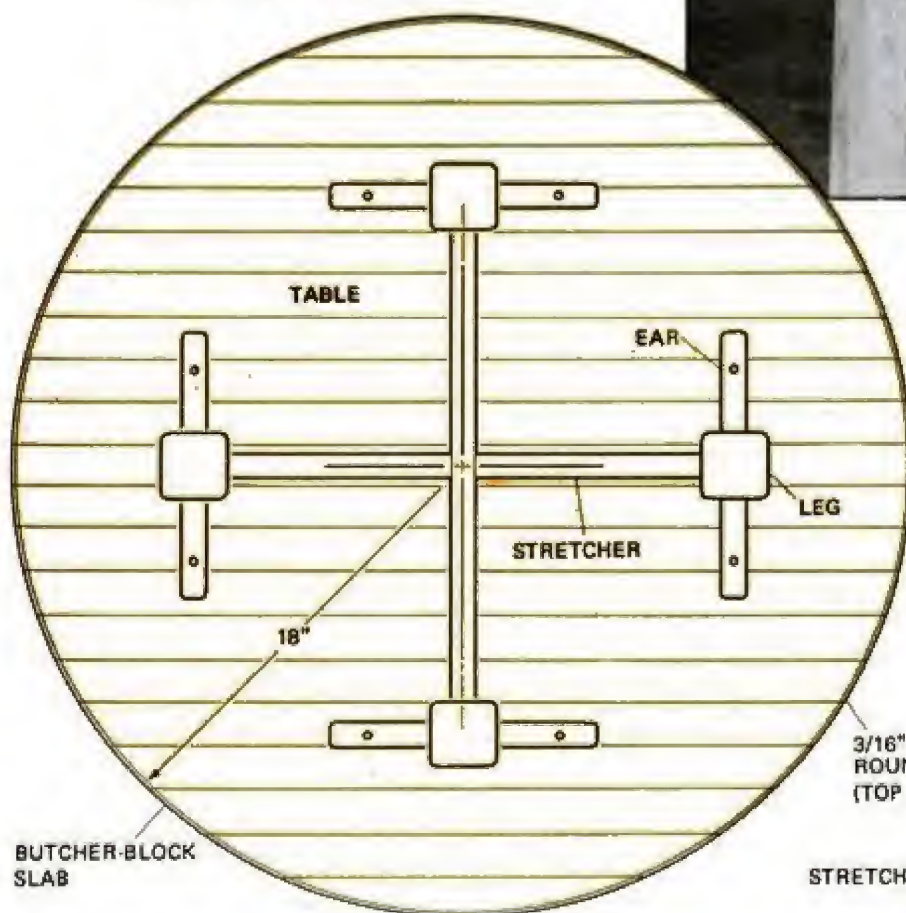
Block maple furniture combines clean, modern styling with rugged good looks.

by Mike McClintock HOME AND SHOP EDITOR

PM photo: Harry Hartman



Well-oiled, 2-in.-thick maple tabletop shows off elegant butcher-block grain that used to be reserved for use in the kitchen. PM's modern designs will look great in your living room.









hide or minimize blemishes. For shadow skids (a visual detail that makes the furniture "float"), rip 2 in. off the bottom of each side and trim skids to dimensions shown to give a 1/4-in. reveal around the edges that meet the butcher block sides.

For the fascias, rip two 32 1/2-in. lengths 6 1/4-in. wide from 4/4 maple. Sand down all butcher block and 4/4 maple pieces, finishing with No. 220 grit. Then, with a 3/16-in. self-

guided rounding-over bit, kill all the hard edges except along the base of the large side panels.

Stain the skids ebony for contrast and, when they're dry, apply Watco teak oil to the surfaces. Attach the skids to the side pieces with 5/16 x 3-in. lagbolts and washers only, with 7/8-in. dia. counterbores for wrench clearance.

### Poplar framing and cleats

■ **Base framing:** Cut all base members and cleats from 5/4 poplar and assemble with glue and 2-in. No. 10 FH screws. Drop the cleats 5/8 in. down from the top edge of the base frame.

■ **Back frame:** Rip enough 5/4 poplar to frame the back and fasten the ends with glue and 2-in. No. 10 FH screws. Finish by adding the two 3/4-in. plywood panels with glue and 4d box nails.

■ **Upholstery:** Seating

### HOW TO ORDER PM'S PLANS

PM is offering a full set of working drawings for the table, chair and couch, with detailed instruction booklet for \$7.95. Send your order to Popular Mechanics, Home and Shop Dept., Box 1014, Radio City Station, New York, N.Y. 10019.



The comfortable chair seat is supported by a weave of rubber webbing. Use a tack hammer to drive the No. 14 tacks.



The webbing is recessed into the frame to provide room for 1-in. foam. Staple it to cleats and cover with muslin.

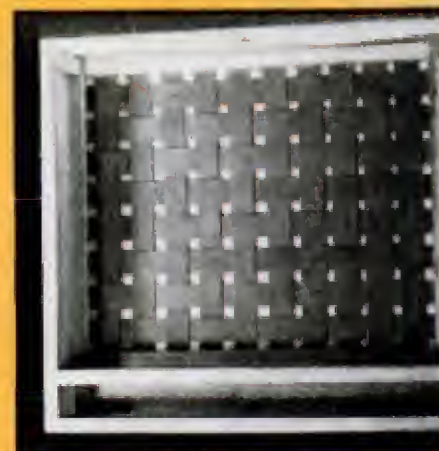
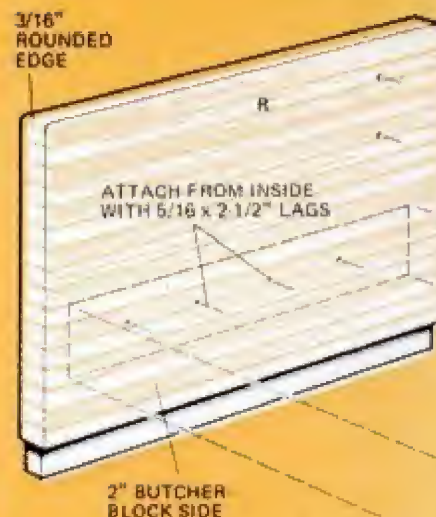


Foam is applied to the back frame with contact cement; then edges are turned over and stapled at the bottom and sides.



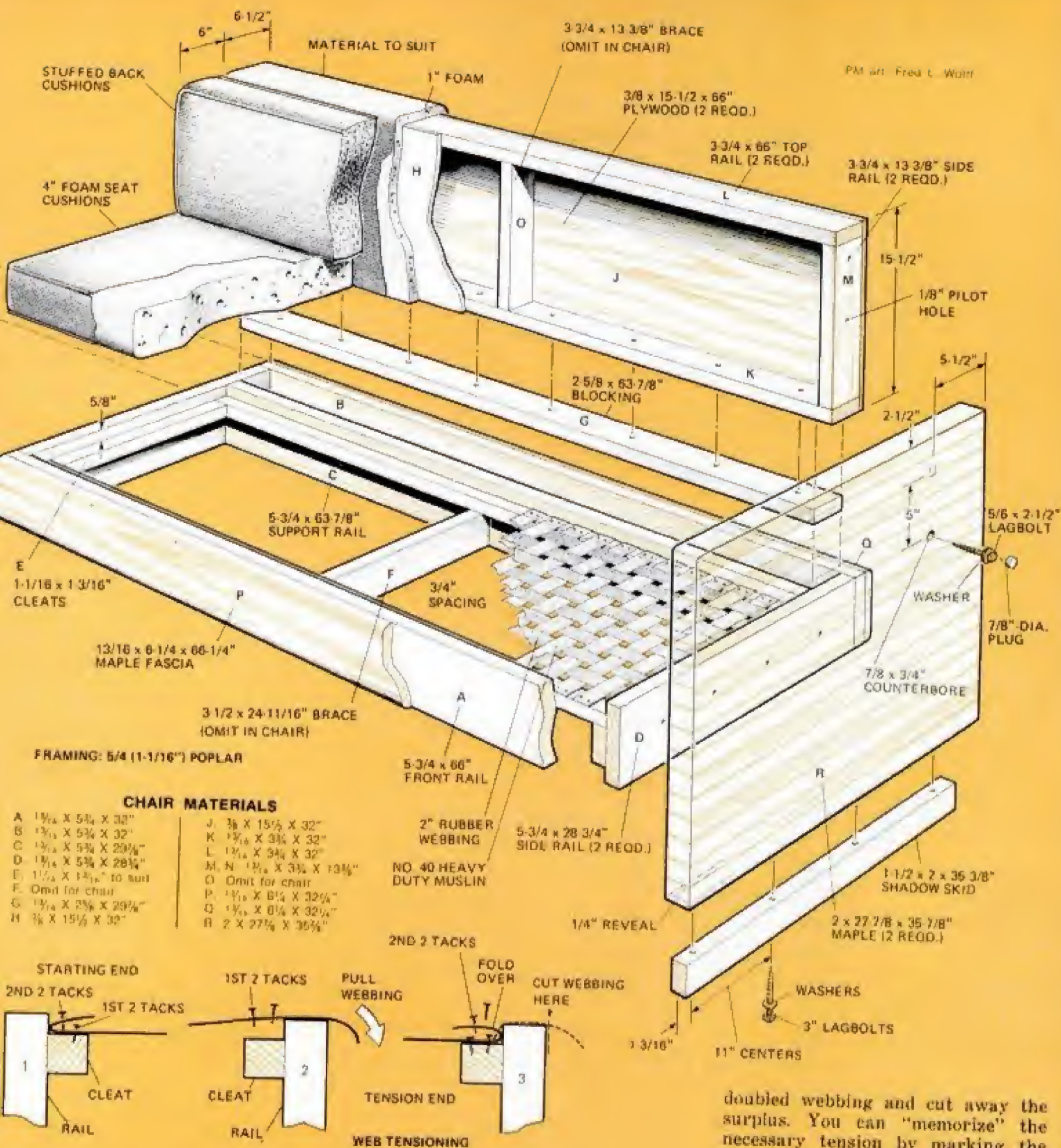
After attaching the back to the base, you staple the 6-in. "tail" of the fabric from the back onto the rear seat rail.

### BUTCHER-BLOCK COUCH



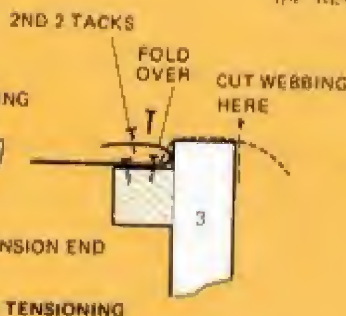
Lagbolting is done through the space between the two back rails (top). In the side panels, lags are recessed and covered with maple plugs. To keep the fabric wrinkle-free, make folded "hospital" corners all around. For a job like this the Duo Fast electric stapler (\$45) is a timesaver.





### CHAIR MATERIALS

A	1 1/2 x 5 1/4 x 32"
B	1 1/2 x 5 3/4 x 32"
C	1 1/2 x 5 3/4 x 29 1/2"
D	1 1/2 x 5 3/4 x 28 1/2"
E	1 1/2 x 1 1/2" to suit
F	Omit for chair
G	1 1/2 x 2 1/2 x 29 1/2"
H	3/4 x 15 1/2 x 32"
J	3/8 x 15 1/2 x 32"
K	1 1/2 x 3 3/4 x 32"
L	1 1/2 x 3 3/4 x 32"
M, N	1 1/2 x 3 3/4 x 13 3/8"
O	Omit for chair
P	1 1/2 x 8 1/4 x 32 1/2"
Q	1 1/2 x 8 1/4 x 32 1/2"
R	2 x 27 1/2 x 35 3/8"



doubled webbing and cut away the surplus. You can "memorize" the necessary tension by marking the lengths from your sample, and pulling the others to fit.

To complete the seat, use the same fastening procedure on the remaining sides and weave the webbing over and under, alternating rows as you go.

Install 1-in.-thick foam in the recess formed by the sides and rails and edge-staple the foam to the cleats. Then stretch No. 40, heavy-duty muslin over the foam and staple it to the rails and sides at the edges. You don't need single, large sheets of foam to do the job. Smaller widths

(Please turn to page 164)



# Make your Christmas bright

Personalize this year's tree with your own decorations.

by Penelope Angell

ASSISTANT HOME AND SHOP EDITOR

**T**hese are our suggestions for adding sparkle to your Christmas tree. Try "curling" long wood shavings to make a peacock in full plumage. Loop strips of walnut, birch or other wood trim into Christmas orbs. Give holiday shapes and bright colors to plywood like our angel, dove and gingerbread boy. Or join copper, aluminum and brass together for shining Christmas stars. Try your hand at making a stained glass poinsettia. Create your own designs with these materials for a personalized tree.

Decorations of natural wood and metal join with brightly painted and stained glass ones to make an individualized Christmas tree.



## 1 Wood-strip decorations

Wood shavings used in the peacock are made by running a plane over a soft pine board. Walnut and other wood veneers, as in the Christmas balls, are sold at lumberyards. We found the 1/2-in. width best to use. Both materials are shaped; then glued with white glue and held with tape (or bobby pins) until the glue dries. Wood shavings can be colored with water-base markers; they must be moistened before shaping.



Wood shavings (left) and wood trim are glued, held with tape or bobby pins.

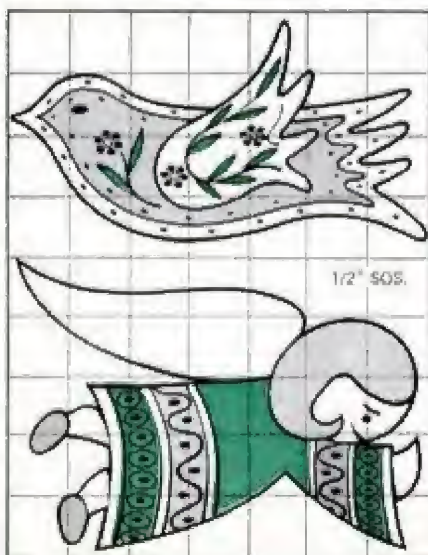
## 2 Painted plywood

You will need a jig saw with a fine blade for sawing intricate shapes in this project. A Dremel Moto-Tool is helpful.

**Materials:** Carbon paper, 1/4-in. finished plywood, sandpaper, Plastic Wood, enamel undercoat and paints, fine paintbrush, clear decoupage finish, screw eyes.

**Method:** Draw the pattern to full size, trace it on the plywood and saw it out. Sand the edges and fill any holes with Plastic Wood. Apply the undercoat and let it dry. Do the same on the reverse side, then sand lightly. Paint the design you wish or follow our suggestions, having drawn or traced the design on both sides of the plywood. Use two coats of paint and sand between them.

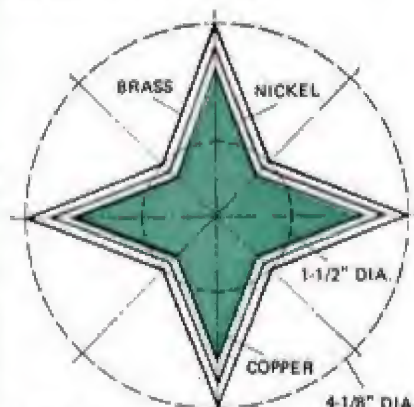
After the paint is dry, twist a screw eye into the figure top and apply the clear finish. We hung the figure and applied finish to both sides at once. Three coats give a durable finish.



## 3 Metal stars

Metal stars are cut from nickel, brass and copper found in hobby stores and are glued with contact cement. Texture is made by hammering the metal on a wood rasp or by using an icepick.

To make the Bethlehem Star, cut the brass pattern twice and the nickel and copper ones four times each. Halve the nickel and copper ones vertically. Slit a brass piece from the top star point vertically to the middle; slit the other piece from bottom to middle. Slide the two together and glue. Position the nickel and glue. Do the same with the copper.



BETHLEHEM STAR

The pattern for the eight-pointed Star Flower is made by joining two 1 1/4-in. squares of copper together. Patterns for the brass and nickel designs are made using 3-in. and 2-in. squares respectively, and rounding the corners. The eight petals of the copper flower are based on 1-in. squares. You can use a sharp scissors or tin snips to cut the thin metal.



Star Flower, the eight-pointed design, is based on two squares combined.

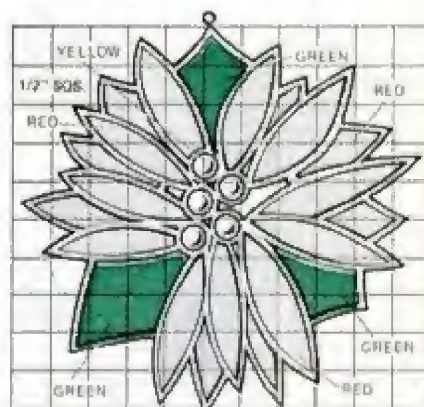
## 4 Stained-glass poinsettia

Make a poinsettia that glows next to your Christmas tree lights.

**Tools:** Glass cutter; breaking pliers to break off small glass pieces; groziers to remove excess glass bits; 25 to 100-watt soldering iron; hardboard work surface; safety glasses.

**Materials:** Five 3/4-in. yellow glass jewels; 1/2 to 1 sq. ft. each of red and green glass as thin as available; 1-lb. spool of 60/40 solder; one roll 3/16 or 1/8-in. copper foil (depending on glass thickness); one 6-ft. strip of lead came with a 1/4-in. U-channel; flux (oleic or zinc chloride); kerosene; carbon paper; oaktag paper; burnisher.

**Making the design:** Draw the full-



size pattern and make a copy on oaktag. Cut out each piece of the oaktag pattern; place them on the glass.

**Cutting and breaking:** Note: Before cutting the glass, practice on glass scraps. Dip the cutter in kerosene to lubricate it. Score the glass by drawing the cutter toward you in one firm stroke. Grasp the glass on each side of the score with thumbs and index fingers and make a fist. A quick up-and-outward motion will separate it on the score. To break small glass pieces, use breaking pliers; smooth leftover nubs with grozing pliers. Place the pieces on the pattern to check the fit.

**Leading and foiling:** Wrap the jewels in the U-channel of the lead came and cut it with sharp scissors so the ends butt together. Wrap the copper foil around the glass edges so an equal amount of foil is on both sides. Overlap foil ends 1/4 in. Burnish the foil to the glass.

**Soldering:** Apply flux with a brush to the foil and lead; reapply during the soldering. Spot-solder several joints by heating solder with the iron and letting the solder flow along the copper foil. Then solder the copper on one side of the piece. Let cool, then solder the other side. At a strong point, solder a wire loop to hang the piece. Wash the poinsettia with soap. Supplies are available from Glass Masters Guild, 621 Sixth Ave., New York, N.Y. 10011. ★★★



# Two enchanting dollhouses you can build

Here's total living on a small scale in PM's world of miniatures.

by Penelope Angell  
ASSISTANT HOME AND SHOP EDITOR



**HANDMADE  
WITH CARE**

It's grandeur on a miniature level in this stately Victorian house. These lifelike accessories and much of the furniture are from Craft Creative Kits, Elmhurst, Ill. The Victorian sofa, chair, bathroom fixtures and kitchen appliances are from Mini Mundus, New York, N.Y.





**W**elcome to the world of miniatures by way of our Victorian and town houses. You can build either house to give the little ones in your family hours of fun. Many items scaled to miniature size, such as paper shingles and ready-made windows, can aid you in your project.

You'll need several special tools for miniature work. A power saw with a fine blade for cutting intricate wood pieces is necessary. You'll also want scissors for cutting paper and cardboard as well as tin snips to cut sheet metal for accessories.

Other tools to have are: a metal ruler for measuring and cutting against; several utility knives; needle-nose pliers and tweezers for close work; miter box; awl; drill; small tack hammer; and sandpaper in three grades.

#### Victorian dollhouse

This Victorian dollhouse might well become an heirloom in your family. Its dimensions are 34 x 20 x 46-in. high.

The exterior is premade clapboard painted white. Shingles are made from chipboard strips. The sloping roof over the porch is made from three pieces of wood attached to a subroof.

#### Materials

To make the house, you'll need two 4 x 8 sheets of finished plywood, one  $\frac{1}{4}$ -in. thick and one  $\frac{1}{2}$ -in. thick. You'll also need: 8 ft. of 1 x 2-in. pine strips for the exterior trim and porch trim; 8 strips of 22 x  $\frac{3}{8}$ -in. molding for the baseboards and living-room ceiling trim; one strip



Comfortable quarters for a city dweller are found in our town house with furniture from Yield House, North Conway, N.H.; accessories from B. Shackman, New York, N.Y.

$\frac{1}{2}$ -in. wide of decorative molding for the top of the pillars and porch; 16 windows; one door; white glue for gluing joints; rubber cement for gluing wallpaper;  $\frac{3}{4}$ -in. brads for nailing the exterior molding; finishing nails for attaching partitions to the ceilings; 1 x 8 flathead wood screws for joining the outer shell of the house; metal filigree trim for the rooftop (available at lamp stores); piano hinge 24-in. long (a 30-in. hinge is easily cut); two caster bearings for ease in opening the house front; three sheets 22 x 30-in. chipboard for shingles; paint; wallpaper; 18 sheets of  $3\frac{1}{2}$  x 22-in. clapboard siding; latch.

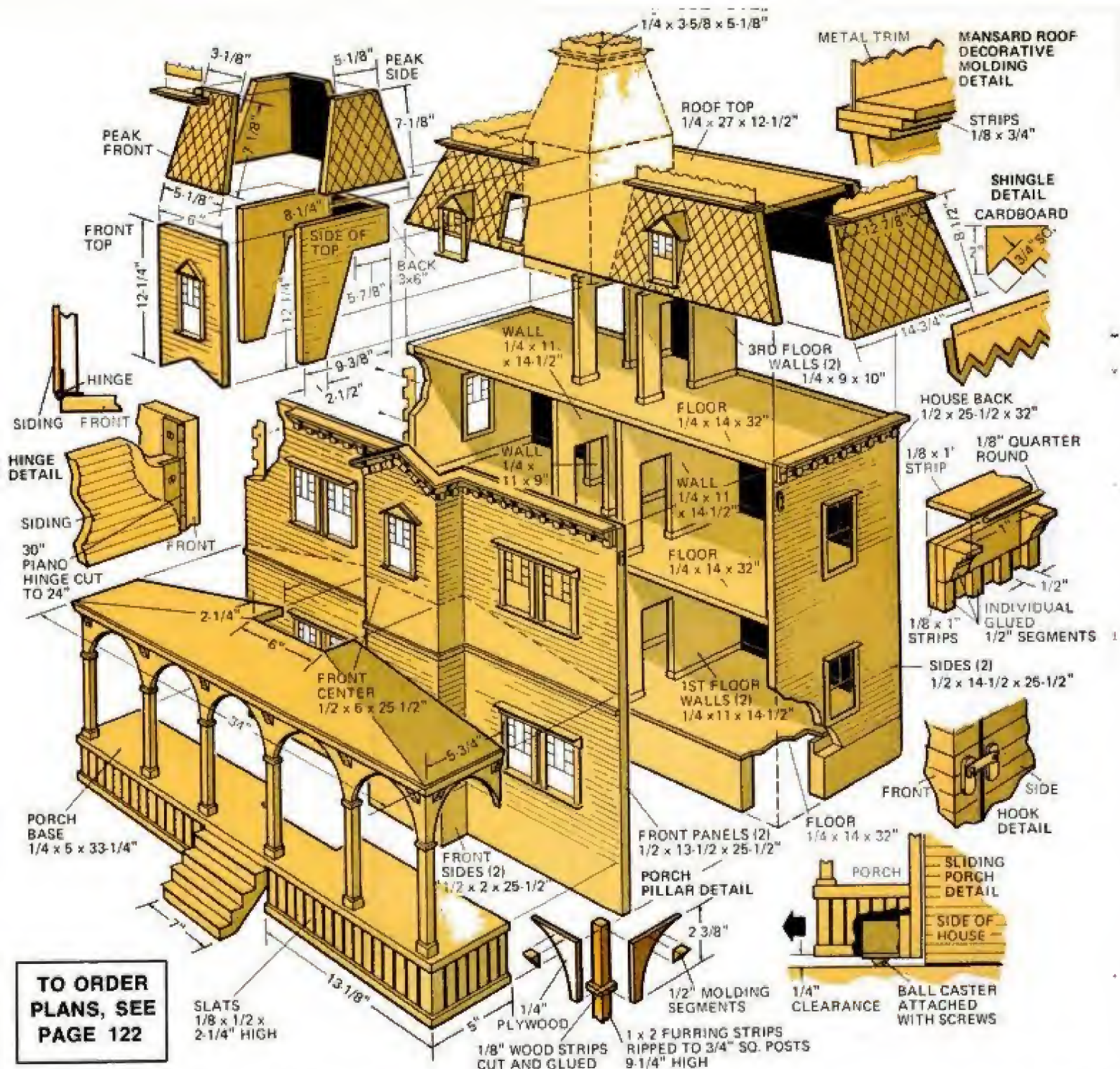
#### Steps for assembling

First cut the pieces out, making proper spaces for your windows and door. Use the layout diagram for the arrangement of parts, but



This 3-story town house can be built in several weekends to delight a young homemaker. See complete plans on a following page.





Needle-nose pliers (right) hold brads as the builder hammers in a delicate place. At bottom right, clapboard siding is being measured.



follow the dimensions given for cutting. Make sure the large pieces fit together before you begin to assemble them.

Attach sides and back with screws in predrilled holes. Join the porch according to the exploded drawing and attach it to the house front. Construct the roof. Glue the roof trim and paint it black. Install painted

(Please turn to page 121)



The front swings open and the roof detaches to reveal the complete interior of the house.







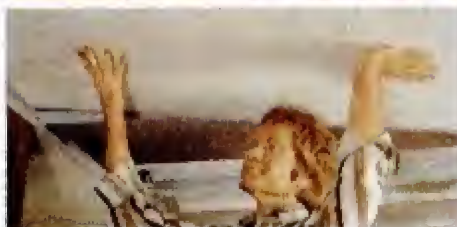
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Introducing the suspended ceiling that doesn't look like a suspended ceiling. Look closely. You can barely see the metal grid. Armstrong has carefully designed this new ceiling so the color-matched grid is part of the ceiling pattern, not an interruption. And because this is a suspended ceiling, wall-to-wall beauty is just one of the benefits. It's easy to install and easy to keep looking fresh and new. If a panel gets damaged, just lift it out and lay in a replacement. No staples or glue, no muss or fuss.

The pattern above is called Scotch Pine, and its rustic board-and-plank look seems to make the whole recreation room more inviting. Scotch Pine is washable and fire-retardant, and because it's a suspended ceiling, the panels simply lift up and out of the way for easy access to pipes,



wires, and ducts above. You also can put lights where you want them, like over a pool table.

You can install a beautiful new Armstrong Scotch Pine suspended

ceiling almost anywhere in your home. Briefly, here's how:

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Your Armstrong ceiling retailer can show you a broad selection of suspended ceilings. He has everything you need: ceiling panels, Super White grid, lights, and easy-to-follow instructions. Find him under "Ceilings" in the Yellow Pages. Or send us this coupon, and we'll send you his name and our free full-color brochure.

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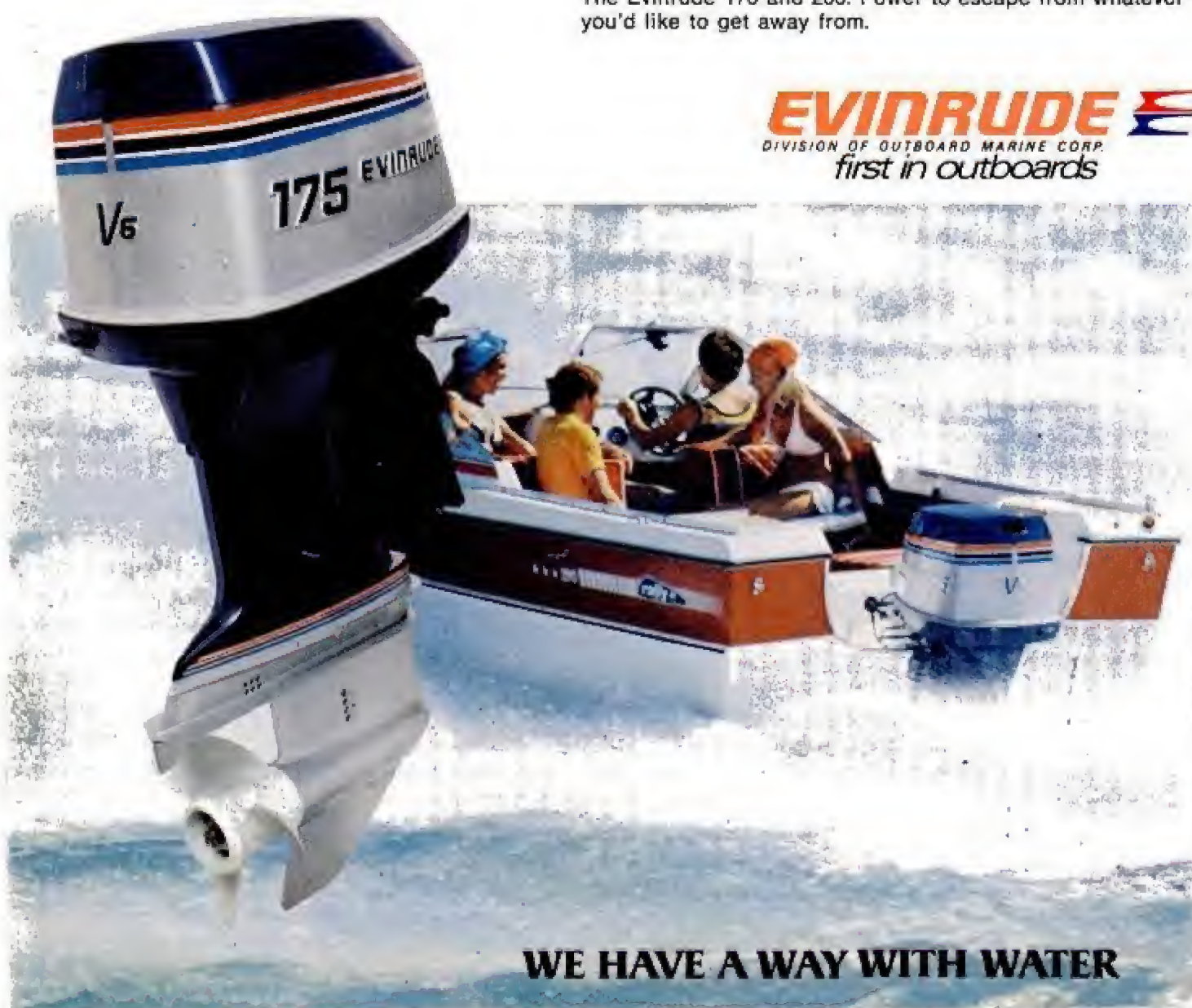
You can go where the fun is fresh. And get there ahead of the rest with a high-performance 175 or 200 hp Evinrude V-6 that cruises faster than most motors can run. An exciting motor that takes you to new and exciting places. Lets you go, with friends. In a big, comfortable boat.

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It lets you ski as good as you know you can be.

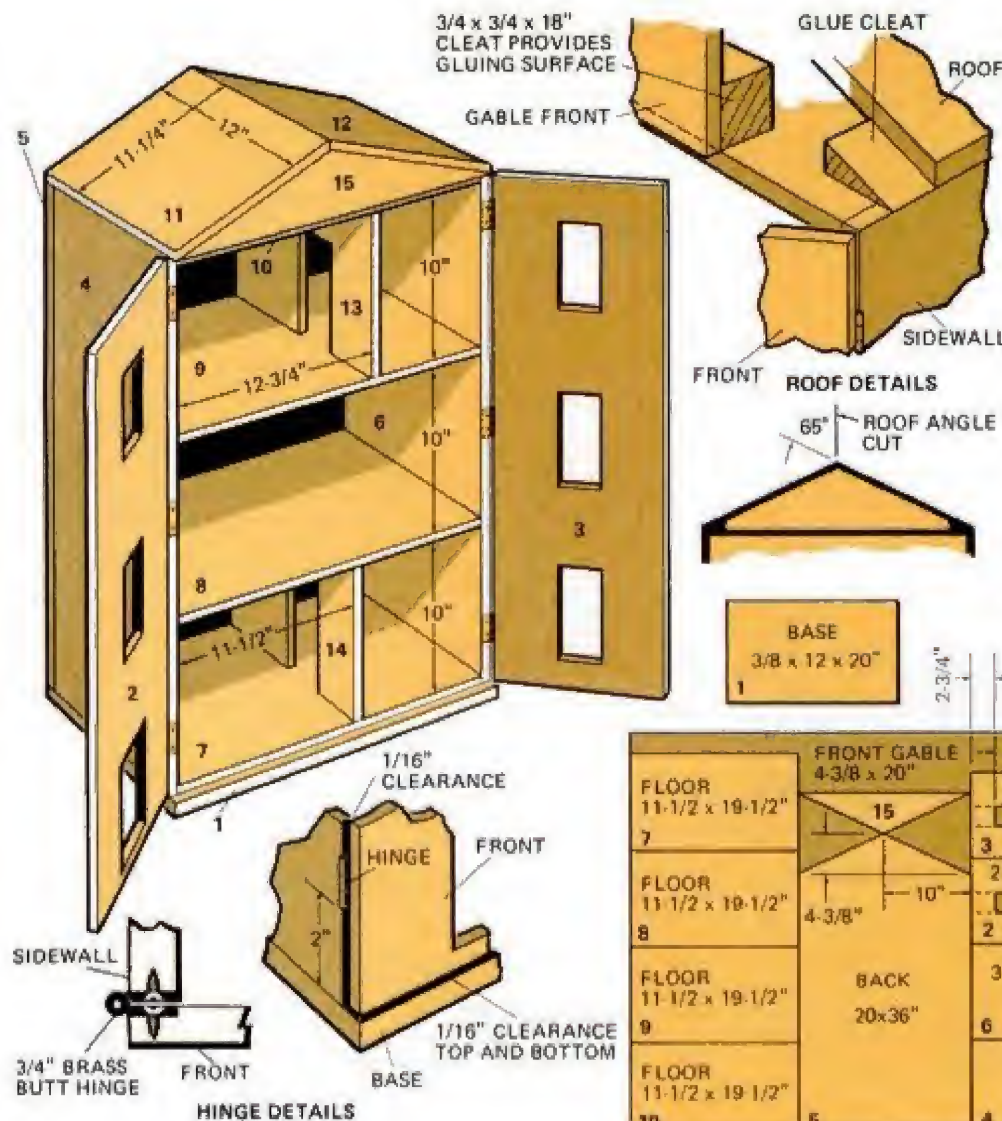
The Evinrude 175 and 200. Power to escape from whatever you'd like to get away from.

**EVINRUDE**   
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*first in outboards*



**WE HAVE A WAY WITH WATER**





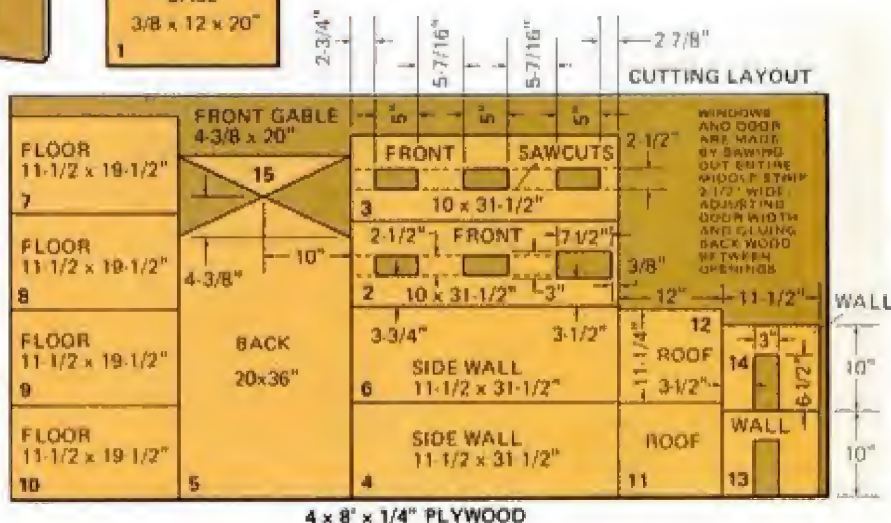
## Steps for assembly

House dimensions are 12 x 20 x 35-in. Follow the dimensions given when cutting.

Assemble the house by nailing the first floor to one side of the house. Insert first-floor partition; glue it to floor; nail it to the ceiling (second floor) and nail ceiling to the house side. Nail the third floor to the side of the house; add its partition and ceiling as with the previous floors. Nail the other side of the house to the floors, and add the roof. Paint, wallpaper and stain the interior.

Paint the inside of both house front panels white and insert the door and windows (also painted white). Hinge each front panel to the house with three 3/4-in. hinges. Nail on the house back.

Add decorative molding to roof and paint exterior trim white. Apply exterior brick and shingle paper with wallpaper or rubber cement. You might add door hardware available from suppliers of miniatures and a magnetic catch to keep doors closed when the dollhouse is not being used.



## DOLLHOUSES

(Continued from page 118)

windows and door. Paint and paper the interior.

The inner walls are installed a floor at a time. Glue first-floor walls to the floor. Insert the second floor and nail it to the first-floor walls. (You'll have to retouch the nail holes.) For additional strength, pre-drill from the exterior and screw the second floor to the house shell. Continue until all floors are installed. Then nail on the painted clapboard.

Total material cost for the Victorian house, about \$120, includes premade doors and windows we got from Craft Creative Kits. (See page 122 for other suppliers.) You can cut costs if you make all parts yourself.

### Miniature town house

You can build this home in several weekends for about \$60, including some ready-made parts you could make yourself. Floors, trim and most walls are painted. Brick and shingle paper goes on the exterior.

You'll need a 4 x 8-ft. sheet of 1/4-in. finished plywood; 3/8 x 12 x 20-

(Please turn to page 122)

## FURNISHINGS AND ACCESSORIES YOU CAN MAKE

You can represent virtually every detail in life in miniature form. Many of the materials needed are right at hand. The standard scale when working with miniatures is one inch to the foot.

■ **Books and magazines:** Check book club ads for pictures of tiny books. Cut these out and paste them to a piece of wood. The rows of books in our Victorian house bookcase were drawn on strips cut from file folders, folded and glued to form a hollow rectangle.

■ **Bookcases:** The bookcase in our Victorian library was made from 1/4-in. beechwood joined with white glue and decorated with narrow molding.

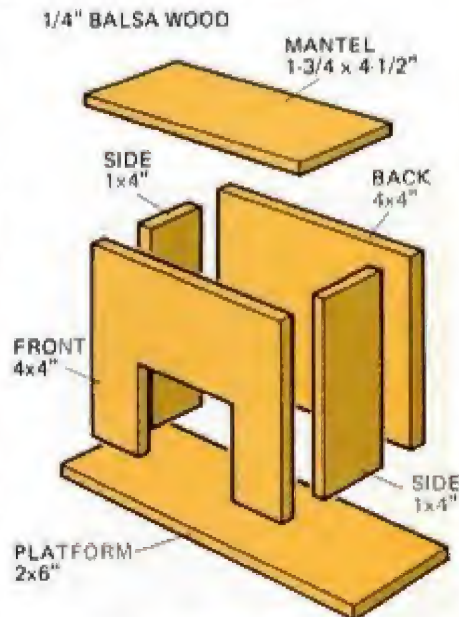
■ **Chandeliers:** Crystal chandeliers can be made from tiny beads glued or wired together.

■ **Curtains:** The curtains for our houses were cut from material that doesn't ravel, gathered at the top and tied back with bits of yarn. You can glue them to the house.

■ **Floor coverings:** Magazine illustrations of carpet and parquet can be glued to the wood floor, then lightly varnished.

■ **Food:** Modeling clay painted with enamel and varnished makes delectable pastries, vegetables, fruit and bread. Or use bits of wax crayons to make fruit.

■ **Stairs:** Precut stringers of thin hardwood to which you can glue treads and risers are available. Or make your own stairs from balsa wood.



■ **Fireplace:** The fireplace in our town house was made from balsa wood cut to the above dimensions. Brick paper was glued to the wood (don't forget the inside) with rubber cement. You might want to try your own design, finishing it with decorative molding and other paper finishes.



# The DO-MORE CORNER

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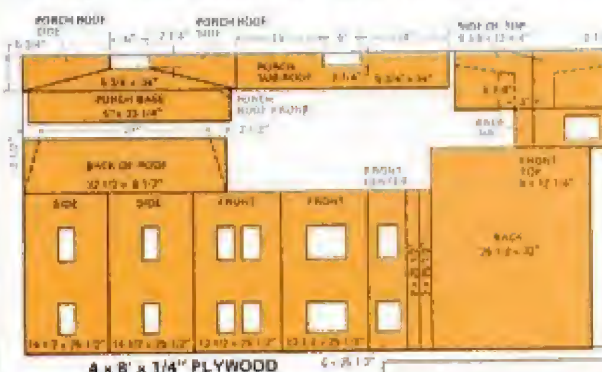
**PLIABLE!** HOBBYISTS FIND VERSATILE PLASTIC WOOD'S PUTTY-LIKE CONSISTENCY IDEAL FOR MAKING WOODEN JEWELRY, COLLAGES AND WOOD SCULPTURES... BUILDING MODEL RAILROADS, PLANES & SHIPS

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## DOLLHOUSES (Continued from page 121)

in. plywood sheet; five windows and one door, ready-made; six 3/4-in. hinges; 1-in. brads; paint; wallpaper (living room, exterior) and paste;

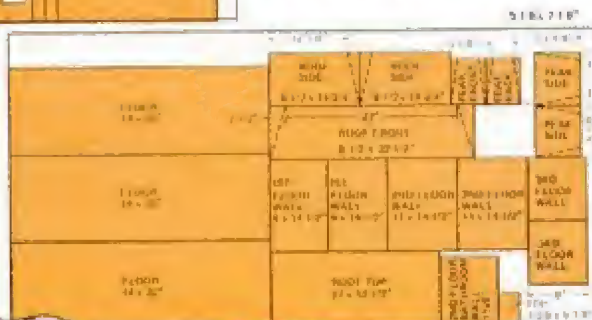
white glue; molding for gable. Follow assembly instructions given with the layout pattern on page 121. You can minimize construction time by ordering prebuilt accessories or have fun making up your own. ★★



4 x 8' x 1/4" PLYWOOD



Follow these diagrams when cutting parts of Victorian house out of plywood sheets.



4 x 8' x 1/2" PLYWOOD

Tiny but total (left) are a Chippendale wing chair and fireplace, both available in kit form from X-Acto.



The modern ceramic bathroom set (above) is a small version of the real thing. It comes complete with metal drains and faucets from Craft Creative Kits.



Small tools for working on miniatures include the Dremel Moto-Lathe (above) and the Moody Maxi Tool Kit (below).



## HOW TO ORDER PLANS

For detailed plans and a how-to booklet, send \$7.95 for Victorian house, \$5.95 for town house or \$11.95 for both to Popular Mechanics, Home and Shop Dept., Box 1014, Radio City Station, New York, N.Y. 10019.

## SOURCES

### Furniture and accessories

- Craft Creative Kits, Elmhurst, Ill. 60126; catalog 50 cents.
- Hobby Craft Miniatures, 118 West Main, Marshalltown, Iowa 50158; catalog \$1.50.
- Mini Mundus, 1030 Lexington Ave., New York, N.Y. 10021; catalog \$2.16.
- B. Shackman, 85 Fifth Ave., New York, N.Y. 10003; catalog \$1.
- X-Acto House of Miniatures, 45-35 Van Dam St., Long Island City, N.Y. 11101; catalog 50 cents.
- Yield House, Dept. 45, North Conway, N.H. 03860; catalog 25 cents.

### Books

- *Complete Book of Making Miniatures*, Thelma R. Newman and Virginia Merrill, Crown Publishing, New York, N.Y.
- *Do/!house Idea Book*, Valerie Jackson and Pauline Flick, Hawthorn Books, Inc., New York, N.Y.
- *Make Your Own Doll Houses and Miniatures*, Marian O'Brien, Hawthorn Books, Inc., New York, N.Y.

### Miniature room displays

- Art Institute of Chicago, Thorne Rooms, Michigan Ave. at Adams, Chicago, Ill.; admission 25 cents.
- Rena's Miniature Rooms, Almond St., Percy, Ill.; by appointment.



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PLASTIC. DRIVES SCREWS  
IN, AND REVERSES TO TAKE  
THEM OUT. CHISELS WOOD  
TO MORTISE A DOOR. LIFTS  
OLD TILE FROM THE FLOOR..  
IT BORES IN CONCRETE OR  
BRICK OR ROCK.**



**SKIL**  
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# The DO-MORE CORNER

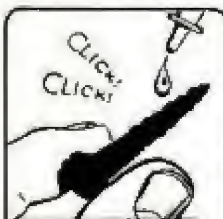
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## FRONT-WHEEL DRIVE HAS ARRIVED!

(Continued from page 94)

back of the transmission. It's as if you took a conventional in-line engine and transmission, turned it 180° and installed it "backward." A completely "backward" layout puts the radiator very close to the firewall, so the fan is usually electric and mounted adjacent to the engine.

Some FWD cars have the radiator at the front of the compartment (also with an electric fan) and run long radiator hoses over the transmission connecting to the "back" of the engine.

The back of the engine, however, could also be considered the front. Although it has the flywheel, clutch and transmission there, it also has the alternator and water pump, which are belt-and-pulley-driven off the camshaft instead of the conventional crankshaft drive. The timing case, sprockets and chain are at the firewall end of the engine. This design, although unorthodox, provides excellent access to the pulley-operated accessories and the radiator.

The transmission shaft layout for engine-in-the-rear is, however, very similar to any in-line arrangement, only in reverse. Power goes from the engine in the rear of the compartment toward the front, into the transmission. It is transferred from the transmission mainshaft to the pinion shaft, which brings it back toward the center of the engine compartment, into the differential, then straight out to the axle shafts and wheels.

In some arrangements, the transmission actually is as much under the engine as in front of it. Power from the clutch shaft is transferred by gears straight down to the transmission mainshaft, which doubles as the pinion shaft. This arrangement also brings the power back toward the center of the engine compartment into the differential. In this transmission, the second shaft, called the intermediate, is below the mainshaft; and the third, which is the reverse gear shaft, is found at the bottom.

At one time Saab and some other FWD cars (such as DKW) had a system called the freewheel, a one-way clutch arrangement on the transmission mainshaft that permitted the car to coast freely by disengaging the wheels and trans-axle from the engine and clutch.

The freewheel clutch did cost you compression braking, but if you wanted you could lock the clutch on and eliminate the freewheeling. The clutch was good for fuel economy

and took some load off the axles, but critics called it a safety hazard.

## Engine and transmission in line—engine in front

If the engine is short enough, it's possible to put the engine first, then the transmission, all in a straight line. This is the arrangement on some Renaults and on the Subaru, which has a horizontally opposed four-cylinder engine.

Even with the short engine, the power has to be brought back toward the center of the engine compartment to give it a straight sideways run to the wheels. In the Subaru, the power goes from the engine into the transmission mainshaft and is transferred to the pinion shaft directly below it. The front end of the pinion shaft has the gear that meshes with the ring on the differential, which is in the side bottom of the front of the transmission.

## Wrap-under transmission

If the engine is too long for the Subaru treatment, part of the transmission can be wrapped around the rear bottom of the engine, as in Olds Toronado and Caddy Eldorado.

The back of the automatic transmission's torque converter bellhousing has a short extension cover bolted to it. This accommodates a sprocket splined onto the turbine wheel shaft from the torque converter. Directly below the sprocket (far enough for the shafts with planetary gears, clutches and so forth to pass under the rear of the V8) is a second sprocket and the transmission input shaft. A chain wraps around both, and power is transferred from the torque converter straight down to the shafts and gearshifting members of the automatic. At the forward end of the transmission is the differential, and from there on the arrangement is standard FWD.

The original Toronado had a planetary gearset-type differential, but all late-model units and the Eldorado are conventional setups.

## Service on FWD

Front-wheel drive has few special service requirements. The FWD driveshaft CV joints do double-duty and cannot be expected to last as long as those in a transmission-to-rear-axle propshaft, but on most cars (some Saabs with grease fittings being an exception), they're "packed for life" with moly grease.

You can lengthen their life by

(Please turn to page 126)



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\*Use only in accordance with manufacturer's instructions

AR-6680

## FRONT-WHEEL DRIVE

*(Continued from page 124)*

having the front wheels dynamically balanced at least once a year, and by replacing shocks at the first signs of deterioration.

Also check tire pressures periodically. Note that some FWD cars run with higher tire pressures in front.

### Axle shaft nuts

Most new FWD models have a separate hub and disc; therefore it is unnecessary to remove the axle shaft nut. However, those models having an integral hub and disc do require servicing as follows.

The nut that holds the hub and disc to the front axle driveshafts must be really snugged down. The range, depending on the car, is 145 to over 180 ft.-lb., beyond the capacity of a 0-100-ft.-lb. torque wrench used by most Saturday mechanics.

The only time you have to worry about this (unless you get into some pretty advanced work) is if the discs must come off for resurfacing or replacement during a brake job. Only solution: Invest in a higher-capacity torque wrench (multiplication adapters are available, but it's usually cheaper to buy a new wrench).

### CV joint boots

The CV joint rubber boots are very important factors in the life of a CV joint. If they're torn, dirt can get in and lubricant can get out. Replacement, however, is something you probably should leave to a professional for, among other things, it takes a special tool to properly fit the metal band clamps that hold the boots.

### Wheel nuts

You may have heard that the wheel nuts on FWD cars must really be tight, but that information is not applicable to all, so check specs. Yes, it's 130 ft.-lbs. on Toronado and Eldorado, but it's 65 ft.-lbs. on the typical import.

### Rear-wheel bearings

The front-wheel bearings on FWD, like the rears on a rear-drive car, don't require periodic adjustment and lubrication. However, the rear-wheel bearings are serviced on FWD, for the rear wheels are the free-rolling ones, just as are the fronts in a rear-drive car. Clean, repack with wheel-bearing grease and adjust once a year.

### Towing

Everything's up front, so if the car has to be towed, have the front wheels off the ground. ★★★

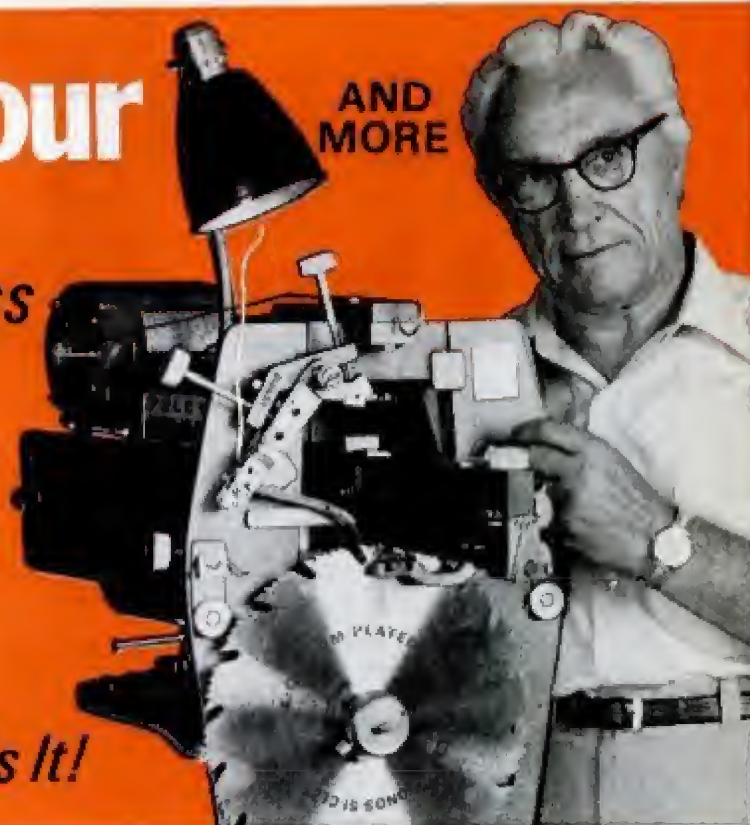


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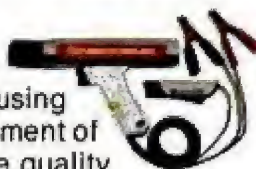
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## EARTHQUAKE!

(Continued from page 67)

current flow in the earth," he explains. Scientists had discovered that dielectric characteristics of the ground change before a quake.

### Animals act strangely

Most Chinese successes have been based in part on reports of the big volunteer corps. And in at least three cases, Dr. Raleigh notes, abnormal behavior of animals contributed to confirmation that a quake was about to hit. The Chinese claim to have found, he says, that shortly before a big shake, rats vacate buildings, horses and cows refuse to enter stalls, chickens won't roost, snakes desert their holes.

"We were skeptical at first," Dr. Raleigh admits. "But the longer we were there, the more convincing a few of those stories sounded."

After the Hollister quake in California, on Thanksgiving Day, Dr. Raleigh and a colleague interviewed ranchers and farmers in the area. Most, busy with festivities, had observed nothing. But one lady who raised blooded horses was with her animals that day and rose to the questions.

She'd found no rationale for their wild behavior. They ran around the pasture in a crazy sort of way, she said. One refused to eat. A well-trained colt wouldn't leave the pasture even when blindfolded. He reared, kicked and had to be released.

"There may be something in it," Barry Raleigh admits. "... it's worth investigating."

### Prediction technology

Meanwhile, an arsenal of instruments is monitoring suspicious areas in this country and others. Air-bubble *tiltmeters* watch for slight changes in ground slope, *seismometers* detect changing seismic velocities in rock, sense little foreshocks and small quakes that may precede whoppers, *magnetometers* look for aberrations in the earth's magnetic field caused by distortions of rock under stress, and *creep meters* check movement along known faults. The swelling of large areas of ground is under the surveillance of delicate *gravity meters* that spot fractions of an inch change in elevation, and *resistivity gauges* check the bedrock's conductivity and density. *Strain meters*, stretching through deep tunnels, measure changes in stretch or shrinkage of the rock, as small as half a centimeter a year in a 10-kilometer expanse. They're so sensitive they'll detect flexure of the earth due to passage of the moon.

More recently, laser ranging devices have been detecting horizontal movement across faults. And the latest tool used in quake prediction is the "golfball satellite"—an orbiting sphere surrounded by corner cube reflectors that will bounce back beams from earth stations, detecting even infinitesimal vertical deformations of the land's surface.

### Panic in the streets

While no responsible scientists believe that any one device or system will provide the answer to dependable prediction, most are confident that combinations of detected precursors will pave the way to accurate forecasts, warning systems and—if necessary—evacuation plans.

Surprisingly, not all experts are sure that alerting the populace is a good idea, though most do. "One can imagine," says the Geological Survey's Dr. Hamilton, "that prediction of a shock near a major city could lead to a drop in tourism, fleeing of the panic-stricken, and convergence on the area by thrill-seekers. Failure of the earthquake to occur could result in recriminations and lawsuits."

"Predictions, however," he adds, "have the potential to provide enormous benefits... save lives, as has already been shown in China. A warning could avert serious consequences from damage to pipelines, storage tanks and nuclear reactors."

Like Dr. Hamilton, most proponents of earthquake prediction admit that potential problems require study, but have few reservations about the benefits. "If people are protected from fire and collapsing structures, if water levels behind dams can be lowered, few lives need be lost, even in strong quakes," UCLA's Dr. Ralph Turner pointed out in a study he conducted for the National Academy of Sciences.

### Help on the way

When can we expect accurate earthquake predictions? A few optimists say five years. But most scientists estimate 10. What about those collapsing buildings and dams? Can't something be done about them? They're getting a going-over, too, as part of an extensive earthquake program. If we can make our structures earthquake-proof, points out Dr. Ray Clough at the University of California in Berkeley, we won't need to evacuate people at all—and billions of dollars of property will be safe in a big shake-up.

To find out what's going on in this interesting area of earthquake-proofing, see the January issue of *PM*. ★ ★ ★

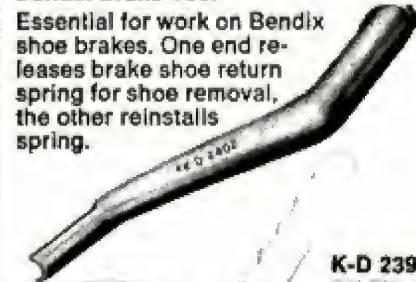
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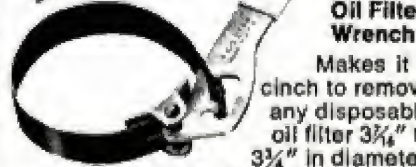
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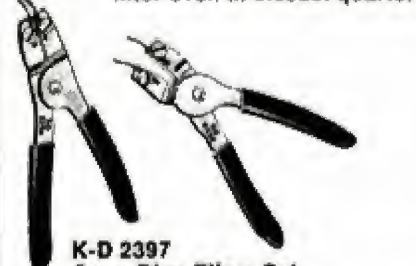


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## A HOT PLANE GETS ITS SEA LEGS

(Continued from page 69)

sensor to detect, track and range targets at distances over 115 nautical miles. It can track simultaneously 24 targets and attack 6 targets. The plane wasn't named the Tomcat for nothing. It carries long-range Phoenix missiles, medium-range Sparrows and short-range Sidewinders. When all have been expended, the crew can rake attackers with a 20-mm cannon.

The Phoenix is a fantastic weapon. These missiles have hit targets from a launch range of 110 nautical miles and have proven effective against high-altitude, Mach 3 targets (which brings the superfast Soviet MIG-25 to mind) as well as small, low-flying cruise missiles. The Phoenix uses its own radar to home in on a target.

The Tomcat has a crew of two. Behind the pilot sits an NFO, whose chief responsibility is the weapons systems. Both are surrounded by radarscopes and electronic displays.

### The Air Boss runs show

The introduction of a new plane involves much more than training fliers. Many specialists—plane handlers, flight directors, ordnance technicians and mechanics, to name a few—must get to know the aircraft. During operations, the flight deck is a busy—and dangerous—place.

No man on a carrier is more aware of this than the Air Boss. He runs the air show from his station high up on the carrier's island. Downward-angled windows give him a sweeping view of the entire flight deck. Every plane that takes off or comes in is under his control. With the *Kennedy's* four cats in operation, a plane can be launched every 15 seconds.

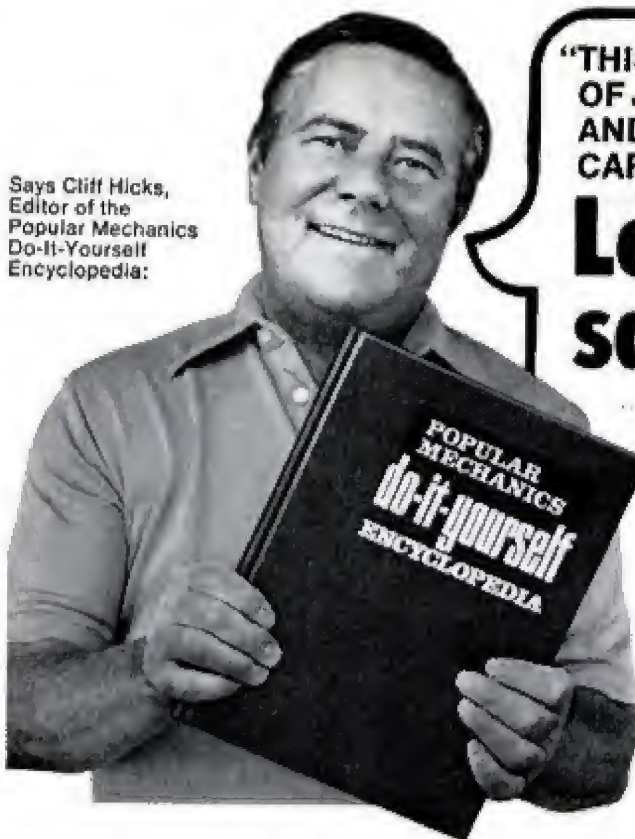
The Air Boss on the *Kennedy* is Cmdr. John (Dutch) Schultz, a seemingly unflappable gent who works closely with an Assistant Air Boss and half a dozen enlisted men, each a specialist.

During operations there's an almost constant murmur of voices: "Oh-one-oh is at the break . . . Oh-one-oh is at two miles, coming fast." "Here's a hummer"—a propeller-driven Hawkeye. "Two-oh-three coming in for a touch-and-go"—a quick touchdown and immediate climb instead of a landing. "Don't launch anything till we get more birds on deck . . ."

Flight training is a repetitive, exhausting exercise. But without it, the F-14 fliers of VF-32 squadron could hardly live up to their motto: "Swordsmen do it to the hilt!" ★★



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## NEW MOVIE MAGIC

(Continued from page 88)

dream sequence in which the comely Danner imagines herself in a romantic interlude with gunslinger Brynner. The two begin a kind of courtship dance. As the tempo of their motions increases, their physical forms blur into electronically induced dreamlike streaks or smears. Finally, the smears merge, representing the ultimate embrace. Meanwhile, also flashing on the screen are computer-choreographed "brain waves"—wildly dancing, changing, kaleidoscopic-like patterns that grow in complexity as Danner's emotions mount.

The effect is unmistakably sensuous, yet completely abstract and inoffensive. While there are some love-making scenes, the picture is only PG-rated largely because the actions are representational rather than actual.

Another sting involves what electronics people call "object simulation." In *Futureworld*, Delos scientists attempt to make a clone, or duplicate, of Fonda. The object simulated is his head and neck which we see isolated on a totally black screen. At first glance, the white bust would suggest plaster of Paris except for the fact that we are looking directly up into a sort of cutaway cylinder of his neck. The facial features are readily recognized as Fonda's, but the thinness of his "skin" plus the fact that we are looking directly across the eerie emptiness of his cranial cavity to the inside shell of his skull creates a strange ghost-like effect.

### A ghost takes work

The unanchored bust rotates slowly before our eyes. We view in turn the sides, then the top of his head as bizarre highlights turn the calcimine-like texture almost to the brightness of chrome or titanium. Nothing quite like this ghostly bust has ever been seen on the screen before.

Creating just this one brief scene took weeks of preparation using highly sophisticated equipment and techniques. First Fonda stripped down to a body stocking and his entire body, including his hair, was coated with flat-white makeup. Then he took a standing position on a rotating platform. Next a slide projector flashed a grid of horizontal and vertical lines on his body. Then three motion picture cameras, positioned 45° apart, photographed him one frame at a time, while a man hiding on the floor under a black velvet cloth rotated Fonda, between takes, until his entire body grid had been photographically documented for computers.

Working with large black-and-white blowups of Fonda's graphlike head and neck, senior programmer Malcolm McMillan sat at a "digitizing table" that contained thousands of wires beneath its surface. McMillan first made a hand tracing of each polygon of Fonda's bust so exact that even the physics of the camera lens were taken into account.

Next, using a "cursor," a sort of electrical light pencil activated by a foot switch, he transferred from his hand tracing over 4000 triangles and rectangles that composed the full 3-D image of Fonda's head and neck. These were then "written" onto magnetic tape and combined with a computer program so that McMillan's mathematical version of Peter Fonda resulted in the 3-D image that moves so eerily on the screen.

### Why a computer?

The advantage of using computer graphics to create such effects is that, once the basic information is fed into the machine, virtually any desired variation on the original subject can be easily obtained simply by pushing buttons and turning knobs. An object, for instance, can be made to move in any direction, tilt, rotate, turn upside down, split in two—in short, do anything you want it to. The procedure produces results somewhat similar to old-fashioned hand-drawn animation—the kind used to make movie cartoons—but does it in a fraction of the time and with infinitely greater dramatic effect.

In still another segment of the film we see the dazzling creation of three Samurai warriors materializing magically from a complex geometric maze of computer-generated triangles. The sequence grew out of a similar effect used in *Westworld* involving a mosaic-like pattern of squares—except that composing moving, overlapping, differently colored triangles was much more difficult.

Such digitized bits of electronic information are called picture elements—or "pixels" for short. Once the pixels—in this case elements representing triangles—are fed into a computer, endless numbers of compositions can be produced—something like playing modern electronic music on a Moog Synthesizer.

### The new breed

*Futureworld* runs through a host of other special effects, including X-ray photography, thermophotography and, in certain operating-room scenes, involving clone construction, that old saw, new ways to put a beautiful woman's body together.

The cinematic innovators respon-

(Please turn to page 136)

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*Henry Morgan*

Henry Morgan

## NEW MOVIE MAGIC

(Continued from page 134)

sible for the movie's effects include three members of the highly imaginative John Whitney family, several engineer employees of California video and electronics companies, and young Brent Sellstrom, special-effects specialist. Together, these men represent a new breed of special-effects experts who create their magic by computer instead of the daredevil stunt men and breakaway furniture of Hollywood's earlier days.

Legend has it that special cinematic effects were born back in the late 1890s by accident. The story goes that a camera in the hands of French moviemaker, George Méliès, jammed. When the sequence was projected, his discovery that a bus turned magically into a hearse eventually opened up the full range of inside-the-camera effects: slow motion, double exposure, stop motion, and the dissolve and fade.

### Techniques grow

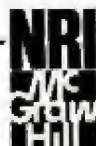
Later, film men learned how to combine pictures painted on transparent glass with live action (*The Great Train Robbery*, 1903) or use a process called in-the-camera matte to part the Red Sea (Cecil B. De Mille's *The Ten Commandments*, 1923). Soon real spiders, cats, lizards and crabs became Gargantuan menaces to miniature men and women. The surge of sci-fi movies in the '50s was inaugurated by Robert Heinlein's *Destination Moon*, in which 2000 light bulbs and 70,000 feet of wiring were used to create a lunar star field.

In the '60s, special effects advances culminated in what John Brosman, author of the fascinating book *Movie Magic*, calls "without a doubt the greatest special effects picture made to date." He was referring, of course, to Arthur Clarke's and Stanley Kubrick's *2001, A Space Odyssey*, a film that, in the pursuit of artistic and engineering integrity, went one year and \$6 million over budget.

### Learning the tricks

The new space-age breed, however, have gone a step farther. They know how to interface computers with film. In the case of the Whitney family—father John, 59, son Michael, 29, and son John Jr., 30—we are dealing with true pioneering artists. As early as 1940, John Whitney began to experiment with the controlled composition and manipulation of circles and rectangles in front of a specially built 8-mm camera. What he pro-

(Please turn to page 140)



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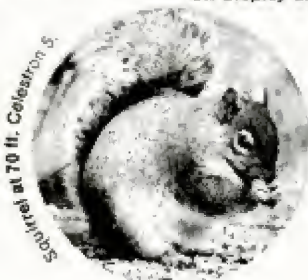
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## NEW MOVIE MAGIC

(Continued from page 136)

duced were some of the first brief "abstract films." Color was later added with various filters.

He next built an optical printer that could zoom in and out and rotate the visual fields around more than one center. He learned how to use movable mirrors to provide image reversal and a change in viewing angle. He discovered he could rewind the camera, add a new color filter and superimpose one or more color images on the original. The possibilities were endless.

Whitney was doing mechanically what an oscilloscope does electronically. In fact, it occurred to John in the '50s that he could save time by switching to what he calls "the technology of the surplus junk yard."

"For just pennies," he recalls, he acquired some surplus analog computing devices that had been used as anti-aircraft gun directors. With backbreaking trial and error, he finally combined electronic equipment—first analog, then digital—that did all the things—and far more—than he could do on his original optical printer.

In simplified terms, the rig he used to create the romantic dream fantasy in *Futureworld* transferred a colored picture sequence created by a meticulously programmed computer onto videotape.

John Whitney does his work in a 10-by-20-foot section of garage in his essentially modest home in Pacific Palisades, Calif. "This is the first time," the distinguished pioneer said quietly, "that I have used computer graphics to represent a human emotion on the screen," referring to the romantic dream sequence.

## Programming 'pixels'

About a dozen Los Angeles Freeway miles away, John Jr. works in Culver City at an ultramodern computer manufacturing complex called Information International, Inc. It was here that he worked with a team that created the computer-manipulated "image simulation" of Peter Fonda and the "pixel" formation of the three Samurai warriors.

Still another dedicated Whitney, son Michael, created the "streaking" or "smearing" effect as Yul Brynner in green and Blythe Danner in yellow perform their courtship dance. Although the exact technique is still so new it is considered secret, suffice it to say that he worked for over three months using an optical-mechanical device employing computer-driven motors for an "effect" that appears

(Please turn to page 142)

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## NEW MOVIE MAGIC

(Continued from page 140)

on the *Futureworld* screen for less than 30 seconds.

Says Michael, "As far as we know, this is the first example of this kind of streak photography using live action figures."

Some of the key *Futureworld* photography made at NASA's Houston center involved two other imaginative masters of space-age electronics: Brent Sellstrom, 33, and Phillip McFadin, 35. McFadin, an electronics engineer who works for Vidtronics, California's largest TV post-production facility, had a highly exacting assignment: Eliminate the bothersome "roll bar" that occurs when a 24-frame-per-second film camera tries to photograph a 30-frame-per-second TV screen. The black roll bar occurs because the shutter periodically opens when an incomplete picture is on the tube.

## Space center is movie set

NASA's Mission Control serves as the real-life "set" for the movie's fictitious Delos Control, the nerve center that directs all of the fantastic doings that occur in *Futureworld*. The trouble was, Mission Control's incredibly elaborate electronic facilities employ scores of TV monitor screens. Trying to photograph Delos scenes on all those TV screens could result in a nightmare of roll bars clearly visible to the audience.

To top it off, co-producers Paul Lazarus III and James Aubrey Jr. wanted to be able to show close-up views of individual TV monitors—a requirement that demanded the complete absence of any roll bars.

McFadin solved the problem by cleverly combining two existing aids—Panavision's servo-driven film camera, which has a variable shutter, and NASA's superb video system which uses an extremely fine 925-line rate to project TV images (compared to the coarser 525-line rate we see on commercial TV). McFadin devised a two-pound "black box" attached to the film camera that enabled it to crank at a steady 20-frames-per-second and assured that its shutter opened only at that fraction of a second when a full screen image was on each of the tubes. When director of photography Howard Schwartz moved in for tube close-ups, NASA's high line count permitted far better quality blowups on theater screens.

The actual filming process was so complex that director Heffron had to replace the traditional cries of "Camera!... Action!" with a multivoiced sequence that went like this: "Roll

(Please turn to page 145)





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**NEW MOVIE MAGIC**  
(Continued from page 142)

sound! . . . Speed! . . . Marker! . . . Roll your tape, Brent! . . . Background! . . . Action!" During shooting, Sellstrom's own hushed command sequence sounded like a casino player talking to himself: "Put three on six. Now 10 on two. Load up one, four and eight. Roll five!"

**New ways replace old**

In old-fashioned movies, special effects men who wanted the picture to take on a "romanticized" or "dream-like" visual quality sometimes used a thumb smear of Vaseline around the edges of the camera lens to fuzz up the outer image and yet leave the center in sharp focus. Optical experts in *Futureworld* created a modern twist. First, they bored a 3/8-inch-diameter hole in the center of an anamorphic (without form) camera lens. Then they mounted the lens on a turret so it could be rotated by the camera's zoom motors. This way, they got screen center in perfect focus and the frame edges appropriately "romanticized" or "fuzzy."

The mid-'70s are seeing a whole new wave of exotic "special effects" movies, among them *Hogan's Run*, *The Man Who Fell From the Sky* and *Midway*. As more and more video and computer-oriented electronics experts get "in the picture," the trend is certain to expose audiences to even newer types of cinemamagic.

**Theater-sized video**

Brent Sellstrom and others who worked on *Futureworld* believe we are only a few years away from a major switch from film to video adapted for movie theater viewing screens. "Right now," says Sellstrom, "the main holdup is the quality of the video picture which has been regulated to fit primarily the needs of the broadcast industry. All we need to do is set a higher standard that will permit theater-sized video."

Still, no matter how far out movie-making techniques get, there will always be the perplexing type of problem that faced the creators of *Futureworld*. After spending four days to light one downtown Houston set and properly position 213 elaborately costumed extras, director Heffron was unable to begin shooting. Reason: One small boy onlooker accidentally released a blue balloon that lodged near the ceiling, well within camera range. After some discussion, an all-knowing special effects man procured an old-fashioned item from a nearby sporting goods store—he shot the balloon down with a BB gun. ★★ ★

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## BEARLD, THE PICKUP TRUCK!

(Continued from page 72)

big as a jacked-up Ford 250 4x4 (truck-ese for four-wheel-drive vehicle) turn over? It's not easy, but one way is simply to broad-slide off a logging road down a cliff. It's for such surprises that roll bars are recommended. Most bolt right into the bed and project slightly above the cab so as to minimize roof damage if you do go on your head. Whether even a hefty 2½-inch-diameter roll bar can protect a two-ton truck adequately is questionable, but at least it'll retard the cab "crush rate."

Another good sporty car idea picked up by off-road truckers is a competition seat belt and shoulder harness. "But I'm not going to race," you protest, and that's all well and good, but the point of the competition harness is that it's a good 3 inches wide and doesn't get tangled like a regular seat belt. The shoulder straps come over both shoulders, meeting the belt at the buckle. It can stop you from hitting the windshield should you come down off a jump the wrong way. A competition belt and harness runs about \$32 and it's sure a low-cost way to stay in the driver's seat.

Lights are a whole subject in themselves. Almost everyone agrees that the standard headlamps used in U.S. cars are underpowered—limited to 35,000 candlepower by an obscure 1935 law. So most authorities look the other way when pickup truck owners (RV, too) install auxiliary road lamps.

### Brighter lighting

The imported auxiliary road lamps have considerably more candlepower—some over 100,000. If self-contained driving lamps attract the police in your area, a compromise solution is to order the driving lamps that come in headlamp form. They simply replace your stock headlamp in the socket and even have high and low beam, though both are considerably brighter than the stock U.S.-made sealed beams.

Most of the higher-quality imported lamps use replaceable halogen or tungsten bulbs, which burn with a much whiter light than American headlamps. When the bulbs burn out, you can replace them without having to replace the whole lamp. The bulbs also come in two wattages—55 or 100, with the 100s putting out much more light but requiring relays to protect your wiring. If you overload your wiring with too much demand from the road lamps, an electrical fire could result. The relays shut off the road lamps before that could happen.

(Please turn to page 150)



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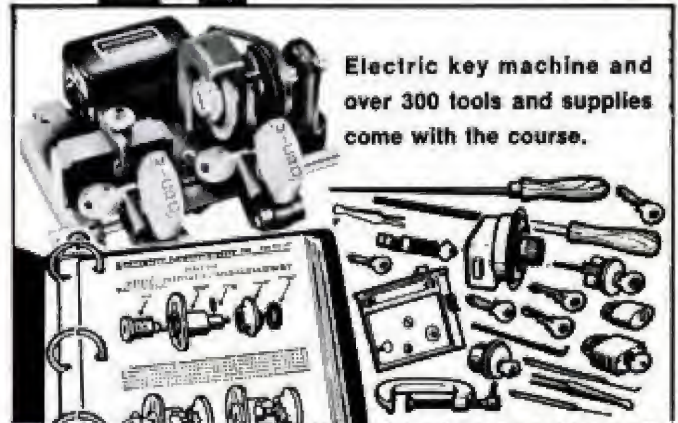
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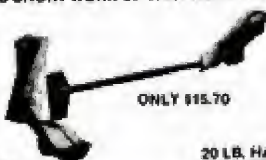
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## BEHOLD, THE PICKUP TRUCK!

(Continued from page 146)

could result. The relays shut off the road lamps before that could happen.

### Plushy truck cabs

If you haven't looked inside a truck cab lately, things are getting embarrassingly plushy. They aren't at the Cadillac level of trim yet, but getting close. For truckers who run the big rims with knobby tires, we recommend additional "cushioning" effect to protect from steering wheel "snap": Install a thick-rimmed rubber or leather-over-rubber steering wheel.

CB radios are almost mandatory items on trucks—even those used exclusively in the city. Off road, they're a lifesaver if you end up in the middle of the Big Muddy with too short a winch line. The favorite mounting spot for a single antenna is the middle of the roll bar; for double antennas (more reach), either side of the cab roof. The higher the mounting, the better the reception. With a hundred manufacturers competing with each other, CBs are now available for as little as \$60, but quality units run \$100 up, not counting the antenna or installation.

About that winch. We found out the hard way how useful one can be. Whether you've got a "working" truck or an off-road purely RV rig, a winch can be handy—for pulling your rig out of a ditch by attaching the cable to a nearby immovable (hopefully) object like a tree. On the farm, they can be used to pull out rocks—you name it. We got a graphic demonstration of the Warn Wrangler II winch when our camera car slid into a ditch while shooting this assignment and the truck owner, using the 12-foot remote-control cable, slickly plucked our car out of the ditch in under a minute. The remote costs more but makes operation of the winch easier since you have full view of what you're doing.

### Pay as you go

Finding out just what products are offered for the truck you own or plan to buy can be almost a full-time job, for a few days anyhow. It would be a whole lot easier just to go to a truck dealer who's an expert and have him set up your rig to suit your particular needs. But when you order a truck fully loaded off the showroom floor, each and every option you include in the purchase price adds to the amount financed, thus adding to your monthly cash outlay. The better way is to order a "strip-po" from a dealer and add the extras as your ready cash permits. ★★



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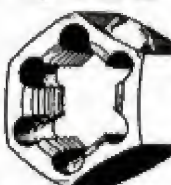
  
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12:27

1. and 2. Hours and Minutes

3. Seconds

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## IGNITION TIMING

(Continued from page 103)

negative terminal post of the battery.

**Caution:** Practically all cars now use a negative-ground electrical system, but there are exceptions. If your car has a positive ground, reverse these connections.

Run the engine at idle and look at the indication. If the reading does not agree with the specification, the distributor point gap should be adjusted until it does.

This is done easily if your distributor has a window through which points can be adjusted externally. General Motors and some American Motors cars have this distributor. You don't have to remove the distributor cap; the adjustment can be made with the engine running.

## Making the adjustment

Lift the window and insert a suitable-size hex (Allen) wrench into the slot of the adjustment screw. With engine running, turn the screw one way or the other until dwell meter shows the correct dwell specification. Remember to close the window all the way.

If your distributor has no window, the adjustment is more troublesome. You'll have to turn off the engine, remove the distributor cap, adjust points blindly, hook up everything and take another dwell reading. You may have to do this procedure several times before hitting the correct dwell.

There's an easier way if you have a remote-start switch or can get a helper. Follow this procedure:

1. Remove the coil-to-distributor high-tension lead from center tower of the distributor cap and ground it by running a jumper wire from the cable's terminal to ground on the engine. This will keep the engine from starting when it's cranked.

2. Remove the distributor cap and put it aside.

3. Connect the remote-start switch to the starter solenoid.

4. Make point adjustment to the degree you think it should be.

5. Actuate remote-start switch. Take a dwell meter reading quickly and stop cranking. There will be a heavy pull on the battery by the starter, so don't overcrank.

6. After getting the right adjustment, button up the distributor, hook up the high-tension lead, start the engine and take another dwell reading. You may need another adjustment; there's a difference between dwell at cranking speed and dwell at idle speed. But you will be close.

## Dwell variation

The dwell variation test checks dwell angle at higher speeds. Generally, there shouldn't be more than 4° difference between dwells at idle and high speeds.

To check dwell variation, warm the engine to operating temperature, disconnect the hose from the vacuum advance chamber on the distributor and plug the open end with a pencil, golf tee or similar instrument. As engine idles, note dwell reading.

Now, increase engine speed to 2000 rpm; check this with a tachometer, combined with most dwell meters in one instrument. A switch lets you change from tach mode to dwell mode.

With engine at 2000 rpm, note the dwell reading—it should be within the maker's specification if he provides a dwell range. If he didn't, the variation shouldn't exceed 4° above the recommended dwell spec.

Excessive dwell variation indicates a malfunction in the distributor—perhaps with the centrifugal advance mechanism—and the distributor should be repaired.

## Time to talk timing

In any internal-combustion engine (except diesel) spark must be delivered to each sparkplug at the precise moment. If spark fires the fuel mixture too soon—before the piston reaches full height (top dead center)—pressure created by burning gases tries to push the piston back as the crankshaft tries to push it up. With a real rise in sparkplug temperature, results could be damaging.

Conversely, if the fuel mixture is fired too late, compression is lost, and with it goes power.

Timing the ignition to get spark at the precise instant to assure maximum power is in keeping with emissions control standards. In most engines this is just before the piston reaches top dead center (BTDC), or at top dead center (0° or TDC). Sometimes a manufacturer sets timing after top dead center (ATDC).

As with dwell angle, ignition timing is measured in degrees of a circle. You can obtain the manufacturer's timing specification from any of the sources mentioned above. Makers also put timing marks on engines to permit an exact setting. In American-made cars these marks have long been placed at the front of the engine on the vibration damper or on the fan-belt pulley.

Timing marks differ from engine to engine. Configurations for various engines are shown on page 103. In several imported cars, timing marks are cut on the flywheel. They are

(Please turn to page 154)



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## IGNITION TIMING

(Continued from page 152)

observed through a small peephole in the flywheel housing at the rear of the engine—on the BMW; Opel 1900, GT and Manta; 1969-70 Peugeot; Renault since 1972; Saab 99; Subaru.

## Using a timing light

To check and adjust ignition timing correctly, proceed as follows:

1. Disconnect and plug the vacuum advance hose.

2. Connect the timing light—how depends on the instrument you use. Attach it to the No. 1 sparkplug.

*Note:* No. 1 cylinder is always the first one from the radiator. On eight-cylinder engines of AMC, Chrysler and GM cars (except Cadillac), No. 1 cylinder is on left (driver's) side. In Cadillac and Ford V8, No. 1 cylinder is on the right.

3. Be sure engine is warmed up and idles at recommended speed.

4. Hold timing light straight and aim it as you would a pistol at the timing marks. To make them easier to see, outline the timing mark and timing mark pointer or index with chalk or white paint. If timing is set right, mark will appear motionless opposite the pointer or index each time the strobe light fires.

5. If timing is not set correctly, loosen the distributor; turn it while watching the timing mark until the mark and pointer are aligned. Use a proper-fitting wrench to loosen the distributor hold-down bolt until the distributor can be turned. Usually, you'll need a special offset type called a distributor wrench.

6. Which way to turn the distributor for correct timing depends on whether you must advance or retard the spark; also whether distributor rotates clockwise or counterclockwise.

## Checking rotation

Specifications may tell you the direction of rotation. If they don't, remove distributor cap and look at the rotor. It may have an arrow imprinted on it to indicate direction. As a last resort, crank the engine to see how the distributor turns, but do this before loosening the distributor hold-down.

When rotation is known, do one of the following for proper timing: If the spark has to be retarded (making it occur later), rotate distributor body in direction the rotor turns. If spark must be advanced (making it occur earlier), rotate distributor body in opposite direction.

7. When timing mark aligns itself, tighten distributor hold-down. ★★



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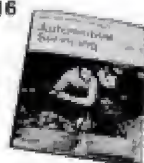
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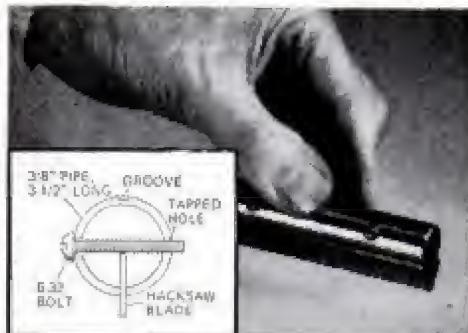
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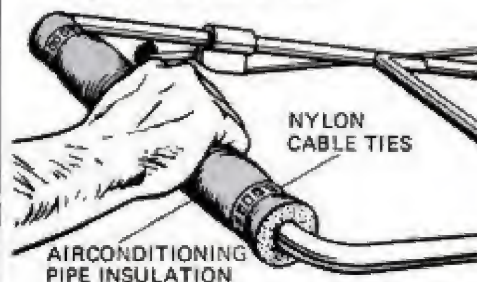
### FROM READERS

#### Handy hacksaw-blade handle



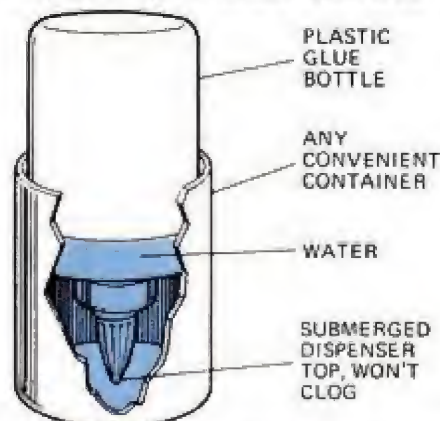
A short length of hacksaw blade has many shop uses. You can make a neat holder from  $\frac{3}{8}$ -in. pipe. Slit the pipe down the center and cross-drill it for two bolts to clamp the blade in the slot. A groove at top lets the pipe "flex" for different blade thicknesses. —Walter E. Burton

#### Give your hands a rest



Make a handrest for shovels, lawnmowers and other tools. Fasten air-conditioning-pipe insulation over the tool handle and secure the foam with nylon cable ties. —K. Suiter

#### Keep your glue bottle operable



To keep a frequently used glue bottle from clogging, store it inverted in a container of water. Air cannot get to the tip to dry any glue remaining there. —Andrew Vena



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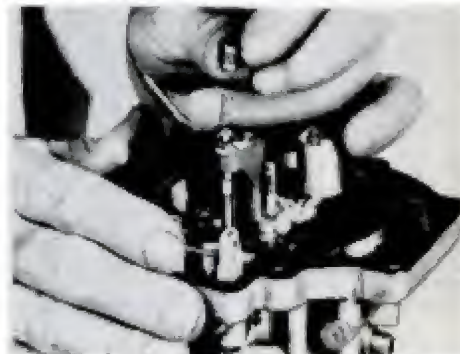
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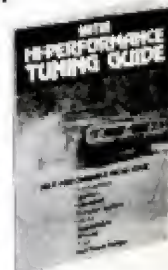
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## FIRE ALARM: NEW HOME APPLIANCE THAT MAY SAVE YOUR LIFE

*(Continued from page 76)*

ture can monitor smoke far from the point of origin because smoke moves, rising up to the ceiling and up stairways," Richard B. Bright states. He is senior research engineer of a special fire-protection project being conducted by the U.S. Bureau of Standards.

A reliable smoke alarm costs about \$30 to \$50. If you deploy more than one, they can be wired together in series so if smoke activates one alarm, the alarms in other areas will sound off, too.

It is at night that alarms earn every penny you spend for them. Sixty percent of fires in the home occur when people are sleeping.

The National Fire Protection Assn. points out that most people who die in home fires are not the victims of flames, but inhale smoke and poisonous gases that rise ahead of the flames.

"Victims suffocate to death in the middle of the night, asleep, never knowing what happened," the association points out. "Many die upstairs from a downstairs fire that never burns a thing on the second floor."

The danger of death by suffocation has reached a point of crisis because of widespread use in homes of synthetic materials, such as polyvinyl chloride. Synthetics are used in furniture, carpeting, drainpipes, shower curtains and other furnishings. When they begin to smolder, deadly chemical gases are given off.

### How detectors work

"Flame is the last on the list of killers during fire," the National Fire Protection Assn. informs us. "Most people die from lack of oxygen, hot air or gases, and from smoke—often before they can awaken."

Smoke detectors are designed to sniff out fumes and warn people of danger before they are overcome. There are two basic types of smoke detectors for the home: photoelectric and ionization.

Photoelectric smoke detectors contain a small light source. When smoke enters the enclosure that surrounds the unit, the light beam is disrupted by smoke particles, causing light to be reflected to a photoelectric cell. This triggers the alarm.

An ionization smoke detector em-

plays a small amount of radioactive material, which is less than the amount used on luminous watch dials. The material ionizes the air in a small pocket, causing a faint electric current. This current triggers the alarm when it's disturbed by fine smoke particles.

Both types work well and are approved by fire safety experts. Many are made by well-known reliable manufacturers such as General Electric, Honeywell, NuTone, Walter Kidde, Gillette, Norelco, Emhart, Teledyne, Master Lock, Pittway, BSR-Metrotec and Pyr-A-Larm. Whatever unit you select, it is important that it carry the UL (Underwriters Laboratories) or FM (Factory Mutual) label. This is your assurance the device has been tested by an independent agency and has met rigid standards.

### Battery or plug-in?

You have a choice of battery or plug-in power. Each has its advantages. Battery-powered alarms are handy where there is no nearby wall outlet to plug into, especially since such sensors should usually be mounted high—on the ceiling or near the top of a wall—to intercept rising smoke and fumes. They also eliminate the possibility that a chance power outage could cause the units to fail to sound off.

But batteries require periodic checking and replacement—a vital precaution to insure proper operation. Any unit you consider should have an automatic indicator, visual or audible, to warn when batteries are low and need replacement. Both battery and house-wired units should also have test buttons because frequent testing is important to insure that the devices are operating correctly.

House-powered alarms eliminate the need for battery changing but require a source of current. If there's no convenient outlet, or you don't want the power cord to show, you may want to connect directly into your house wiring—a neat though slightly more expensive installation. If you do plug into an existing outlet, be sure it's permanently "hot" and not one controlled by a wall switch that could accidentally cut off power. As for a power outage knocking out an alarm before it can sound off, most experts believe the chances of this happening are extremely slim.

Until recently, photoelectric detectors tended to be house-powered because of the need for adequate current to operate the always-on light source. Now at least one company, Gillette, is bringing out a low-drain battery-operated version for those



who want the convenience of cordless installation. And another maker, Master Lock, is offering an ionization-type model that works on house current but has a battery backup power supply. So you have a wide range of systems to select from.

### New laws require alarms

As of this writing, there are already 12 states that require all new homes to be equipped with wired-in smoke detectors. The Federal Housing Administration requires the same for all new homes before an FHA-approved mortgage is issued.

Keep in mind also that some insurance companies offer a reduction in homeowner insurance premiums if a home is equipped with fire alarms.

### Where to locate alarms

The most critical spots in a house where smoke detectors should be placed are bedroom areas. The National Bureau of Standards suggests that at least one detector should be placed on the ceiling or wall of a hallway outside *each* group of bedrooms. If the hallway is more than 30 feet long, a detector should be installed at each end.

If your home has bedrooms on a second (or third) floor, place an alarm at the head and foot of the stairway. A smoke detector should also be installed at the head of a stairway leading to the basement.

Being awakened in the middle of the night by a fire alarm is one thing. Knowing what to do is another. It is ludicrous to install fire detectors and then keep members of the family in the dark about how to act when an alarm goes off.

For example, there have been cases where small children have been frightened to the point of panic by the raucous blast in the middle of the night and have hidden in a closet. Kids should be made acquainted with the noise emitted by alarm units (use self-testing controls) and told what to do when they hear it—not once or twice, but many times.

Richard Strother, who is associate administrator of the National Fire Prevention and Control Administration, points out that as part of a sound fire expectation program families should have an escape plan and practice using it.

"When a smoke alarm awakens you, you'll be groggy and won't be able to think well," he says.

### Safety pointers

Here are points to keep in mind when putting together your evacuation plan and teaching it to your family:

- Every family member should have

at least two escape routes from his or her bedroom. Make sure windows open easily if they are to be used.

- If a means of escape is to be a window high above the ground, you can buy special escape ladders that hook to the windowsill. People who are to use the ladder should know where it is stored and how to employ it. Store the ladder in the same room where it's to be used.

- If there are *no* smoke detectors in the home, sleep with the bedroom door closed. It holds back smoke and gives you more escape time.

When fire strikes, test the door by running your hand over it. If it is hot, use an alternate escape route. If cool, brace your shoulder against the door and open it cautiously. Be ready to slam it shut if smoke or heat come in. If the hallway is clear, you can use your primary exit of escape.

- If the bedroom area is equipped with a smoke detector, sleep with doors *open*. One reason is to allow smoke from a fire starting in a bedroom to reach the detector.

- Establish a meeting site outdoors and count heads to determine if everyone is safe.

- Practice your escape plan with other members of the family over

and over again until everyone is thoroughly familiar with it.

The order of procedure to follow when a detector sounds off is: (1) evacuate; (2) call the fire department; (3) if the fire is small, fight it if your home is equipped with fire-extinguishing equipment.

### Types of extinguishers

Fire extinguishers come in three basic types, designated as "A", "BC" and "ABC". These designations refer to the class of fires each is designed to fight.

The "A" type of extinguisher is filled with water and is effective on ordinary combustible materials such as wood, paper, drapes and upholstery. These are about all it is good for, however, and for this reason the "A" type is seldom purchased nowadays as an all-round household extinguisher. *Never, never* spray water on an electrical fire or flammable liquids (cooking grease, gasoline, oil). On an electrical fire, the conductive stream could cause a lethal shock. On flammable liquids, it will just blast flaming material all over the place, creating greater hazards.

The "BC" extinguisher is filled with dry chemical or carbon dioxide

(Please turn to page 162)

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## FIRE ALARM

(Continued from page 161)

and is used where water can't be—on flammable liquids and electrical fires. The "C" means it can be safely used on electrical fires without danger of electrocution. One advantage of CO<sub>2</sub> over dry chemical is that it leaves no residue—you can put out a flaming piece of meat and still eat the meat.

"BC" extinguishers are handy around kitchens and cars because of their ability to fight grease and oil fires, but they're still limited—they can't handle the conventional "A"-type household fire of wood, paper or cloth. For this reason, the so-called multi-purpose "ABC" extinguisher is recommended by most fire safety experts for general household use. It is filled with a dry chemical agent and is effective against all home fires.

## Work fast

Don't become overconfident, however, just because you have an extinguisher that will fight anything. The typical small-size, home-type dry-chemical extinguisher is exhausted in 8 to 10 seconds. Not much time, so you have to work fast, carefully and without panic. Two important tips that can extend your firefighting range are: 1. If the fire is electrical in origin, turn off the power as soon as it is safe to do so. It can then be fought as a conventional "A"-type fire—with plain water if necessary. Just be sure the power is really off. 2. If the fire is feeding on ordinary combustibles, it is wise to water it down as soon as the flames have been extinguished to prevent rekindling. This may save the day if your extinguisher is empty and the fire starts up again.

## Beware of old tanks

The old soda-acid fire extinguisher is now considered obsolete, ineffective and possibly dangerous. It is no longer being sold, but some may still be found in homes. The Fire Equipment Manufacturers Assn. strongly urges that such units be discarded—but not just thrown out. They should be taken to an authorized extinguisher service center for careful disassembly. (If discarded in trash, they could be unintentionally activated when turned upside down, and an old corroded tank could blow up like a bomb.)

One of the most important bits of advice we can leave you with is this: In case of fire in your home, keep cool. Think! The fire alarms you've put into your home have given you sufficient escape time. Don't blow it by becoming panicky. ★★★

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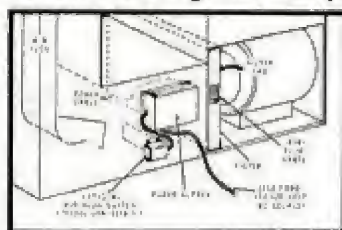


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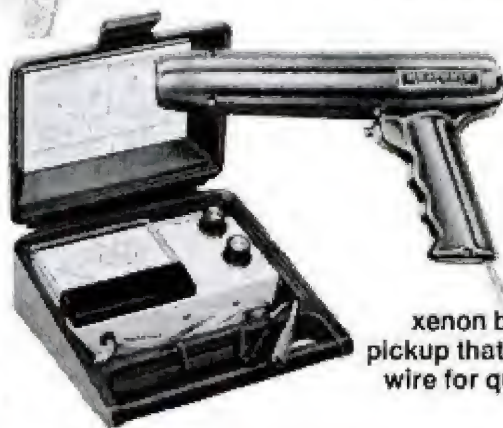


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## PM'S BUTCHER BLOCK DESIGNS

(Continued from page 113)

can be butt-jointed into larger sheets with contact-type rubber cement.

Start with a piece of 1-in.-thick foam large enough to cover the front, rear and top surfaces of the back, and spray these surfaces with contact cement. Spray the entire inside surface of the foam and, when dry, roll the foam smoothly around the three surfaces of the back. You can trim the edges flush with a utility knife.

This layer should also be covered with muslin and stapled on the sides and bottom where it won't show.

### Stretching fabric

To keep fabric wrinkle-free as you stretch it over a surface, drive a tack (or staple) at the midpoint of one edge. Then stretch the material toward the corners, drive a fastener at each end and tack down the space in between. Repeat this procedure on the remaining three sides, removing any scalloping as you go along with additional fasteners. If your fabric has a nap (smooth when stroked in one direction and rough in the other), place it so the smooth stroke goes toward the front on the base and down the front face of the back.

If you use a patterned fabric, you'll have to check the pattern alignment from back to base.

### Basic upholstery

Fabric usually comes in 45 or 54-in.-wide bolts. This will have no effect on the chair, but center seams will be required for the sofa.

Align the fabric on the base, stretch it out, and fasten it to the front rail face and the blocking piece with staples or tacks. Stretch the fabric crosswise and drive all fasteners into the side faces where they won't be seen.

On the back, make sure that fasteners are driven into the bottom and sides. Some tucking or slitting may be necessary at the top outside edges of the back. If you have trouble making the fabric edges smooth, you can try stuffing a little bit of cotton wadding into the voids to even them out.

For now, leave a 6-in.-long "tail" of fabric at the lower rear edge of the back.

### Assembling the pieces

Attach the back to the base with 7/16 x 2 1/2-in. lagbolts and washers. They are screwed in from the bottom surface of the blocking piece—the space between the intermediate (C) and the rear (B) rails. Align the back so that the fabric-covered foam protrudes about 3/4 in. beyond the



protrudes about  $\frac{3}{4}$  in. beyond the face of the rear rail in the base.

This is the time to make sure the base and back form a 90° angle. If they don't, loosen the lags and add shims to make up the difference.

Now stretch the "tail" down and fasten it to the face of the rear rail. Run the fabric ends around corners and fasten them at sides. This completes your back-base assembly.

### Butcher block sandwich

Drill four evenly spaced  $\frac{3}{16}$ -in.-dia. holes along the horizontal centerline of the poplar base sides and punch-mark the inside of the butcher block sides through these holes for alignment.

Using a  $\frac{1}{4}$ -in. bit, drill the punch marks  $1\frac{1}{2}$ -in. deep to accept the lag-bolts. You can save yourself some effort by running a bar of soap over the threads to make them turn more easily in the hardwood.

From the outside of the butcher-block side panels, drill and counter-bore the two holes to install the  $\frac{3}{16}$  x  $2\frac{1}{2}$ -in. lags and washers. Make sure your bit is sharp for this work.

Complete the chair by trimming the ends of the fascias to the exact length between the butcher block sides. Fasten them to the rails from the inside with well-soaped  $1\frac{1}{2}$ -in. No. 10 FH screws.

### Making the table

You can make coffee-table legs out of almost anything from clay flue tile to cast-iron pipe. If you stick to maple, rip enough 4/4 maple to laminate four legs (three pieces in each)  $2\frac{1}{4}$  x  $12\frac{1}{2}$  in. long. Machine a  $\frac{3}{8}$  x  $2\frac{1}{4}$  x  $\frac{3}{4}$ -in. mortise on three sides of the legs, starting  $\frac{3}{4}$  in. from the top. While you build the legs, set the 36-in.-dia. tabletop aside and give the oil finish time to dry.

Rip two stretchers and eight "ears" from 4/4 maple (check dimensions shown). Machine the tenons on ends of the "ears" and notch each stretcher at its midpoint to lock the assembly. Clamp and glue these pieces as a single unit on a flat surface to assure complete contact with the bottom of the tabletop.

To complete the table, place the top (good surface down) on a rug with the leg assembly centered. Drill and counterbore each "ear" for 2-in. No. 10 FH screws. Mark the tabletop through these holes, drill the pilots and assemble.

For a really pleasing finish, rub oiled surfaces (when dry) with 300 steel wool. Apply another thin coat of oil, rub wet surfaces with 0000 wool and remove the excess with a lint-free cloth. A rich luster will make your furniture shine. ★★★



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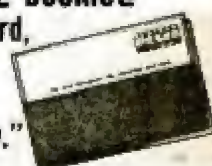
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## ENGINES THAT SHRINK AND GROW

(Continued from page 101)

reasons beyond the scope of this article, maintains the best balance throughout its displacement range. I've heard and felt Pouliot's engine running—have placed my hand on the intake manifold and cam cover—and can attest to its smoothness.

This engine develops a maximum of about 100 bhp in its present state. That's with no attempts to maximize porting or valve size. Meanwhile, one interesting thing Pouliot discovered about this engine is that its torque curve remains almost flat at all displacements and all rpm. In other words, it puts out almost as much torque at 600-rpm idle as at 2800-rpm cruising.

What about compression ratio? The four-bar link adjusters are arranged in such a way that compression ratio remains almost constant, no matter what the stroke. The test engine's c.r. is about 9.3:1. And the funny thing is, it doesn't need any spark control—it runs at its best always firing at TDC (top dead center).

Are there any drawbacks or problems with variable-displacement engines like the Pouliot? Yes, several.

One is cost. Although Pouliot's engine needs no new technologies and no exotic metals or materials, Sandia estimates that because of added complexity and a 10 to 12-percent increase in weight, this variable-displacement engine would cost more to mass-produce than today's V8s. Just how much more no one's saying.

### Emissions problems

Another potential problem involves emissions. When you lengthen the stroke of Pouliot's engine, your piston begins to move in what's essentially a cold part of the cylinder. Cold cylinder walls produce hydrocarbon pollution. Precisely what that'll do to the Pouliot engine's emission numbers we don't yet know. Sandia says, however, that the Pouliot engine will likely need EGR (exhaust gas recirculation) and a catalytic converter, same as a normal engine.

Sandia is presently working on a second generation of the Pouliot engine, this one to be installed in an automobile. Its displacement will sweep from 75 to 255 c.i.d., it'll have a 9.5:1 c.r., and maximum power will be in the range of 150 bhp.

This newer engine—again a Five—will tilt at 40° to the left for a lower hood line and to put the sump nearer the pistons. It'll also have better access to intake manifolding. Sandia expects to have its variable-

displacement car running in about a year.

### Ford's dual engine

This past September, Ford announced plans to introduce a conventional six-cylinder engine that can be switched to run on only three cylinders at cruising speeds. This engine, dubbed a 3x6 and based on Ford's standard in-line, 300-c.i.d., ohv Six, will first appear in pickups late this year. By 1979, Ford hopes to apply the same principles to passenger cars.

The way this engine varies its displacement is very simple. When you need power to accelerate, the engine fires on all six cylinders. But if you're cruising or decelerating, a mechanism controlled by electronic signals automatically shuts both the intake and exhaust valves of three cylinders, and the engine continues to run on the remaining three.

### Deactivating mechanism

To run that back in slow motion, Ford engineers have rigged up electronic sensors that receive information from the transmission and monitor vehicle speed, manifold vacuum, throttle position and engine temperature. This information goes into a "black box" (computer), which decides when to deactivate the rear three cylinders. This usually occurs in the cruising mode above 45 mph.

The actual deactivating mechanism works like this: The individual stamped rocker arms are permitted to ride up on their studs by a rotating cylinder above each one. Turning the cylinder releases the rocker, which means the intake and exhaust valves stay shut. To reactivate the valves, the cylinders are counter-rotated. There's a spring between the cylinder and the rocker arm that cushions engagement and disengagement.

What, you ask, happens to the gasses trapped inside the three deactivated cylinders? "The nonworking cylinders aren't really pumping anything," a Ford engineer told me. "It's more like an air spring situation. There's no compressive work being done."

Friction losses in the nonworking cylinders amount to about two percent, so these, too, are negligible.

Again, what are the drawbacks? Well, first, the engine runs pretty rough on only three cylinders. I understand, too, that there's a noticeable jounce when the engine passes from three to six and back. The emissions situation here hasn't been worked out totally, but Ford seems to feel it can lick it. Meanwhile, sev-

eral dozen test vehicles are moving up toward a million miles.

### Other shrinkers and growers

Dual-displacement and variable-displacement engines go back at least as far as 1916. That year the Enger Motor Car Co. of Cincinnati offered an ohv V12 that could be run on 12 or only six cylinders. A lever opened the valves of one bank and at the same time stopped gasoline flow to that bank. This engine put out 55 bhp at 3000 rpm on all 12.

In 1945, an engineer named Howe H. Hopkins began work on a 10-cylinder, barrel-shaped engine at the behest of Sam Eckert, chairman of the board of Sun Oil Co. Eckert financed the project personally.

Hopkins' engine used pistons and adjustable swash plates. Displacement could be varied from 98 to 241 c.i.d., and the engine ran for 400 hours without problems. In the early 1950s, Hopkins showed this engine to all major U.S. automakers, and while they acknowledged its benefits, they turned it down on grounds of complexity and higher manufacturing costs. Hopkins' prototype engine now rests in the University of Wisconsin and is used for teaching.

### GM's experiments

General Motors has been working on dual-displacement engines since 1958 and has found fuel-economy improvements similar to Ford's. Those gains, however, were associated with increased exhaust emissions. GM's experiments have used both fuel injection and carburetors controlled electronically and mechanically. GM says its engineers are still studying dual displacement as a general approach to better gas mileage.

Chrysler Corp. worked on an 8x4 engine (a V8 that can run on four cylinders) last year, but has suspended experiments for the time being. Actually, Chrysler's tests with dual-displacement engines go back 35 years.

Overseas, Daimler-Benz has reportedly toyed with another 8x4, and a company in Germany called Howerke described an engine in 1958 in which cylinders could be deactivated singly or in pairs.

For the moment, the Ford and Sandia engines seem to offer the most promise among those that shrink and grow. But even their developers admit they need quite a bit of work. However, until some revolutionary powerplant comes along to replace the reciprocating piston engine, these variable-displacement and dual-displacement jobs might be an interim solution to help conserve gasoline. ★ ★ ★





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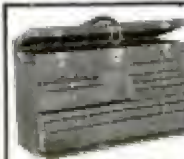
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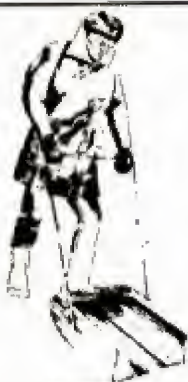
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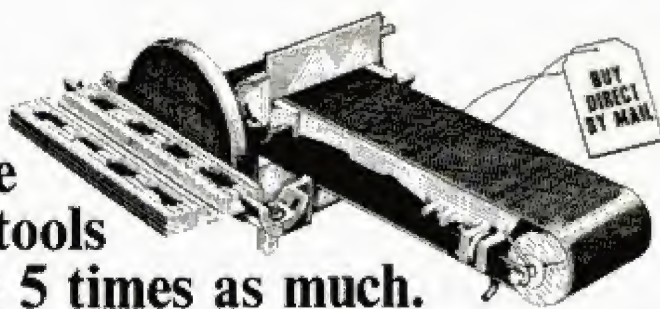
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(Continued on next page)



## BUSINESS OPPORTUNITIES

(Continued from preceding page)

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(Continued on next page)



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(Continued from preceding page)

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**BEERMAKER'S** Supply Catalog—Free. Bacchanalia, 273 Riverside Ave., Westport, Conn. 06880.

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